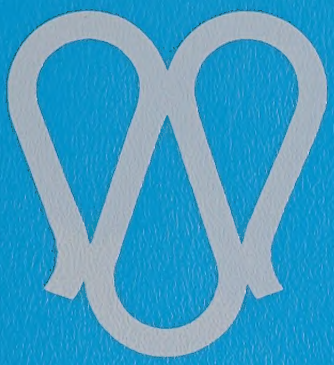

OPERATING INSTRUCTIONS
for
UNIVERSAL AMPLIFIER
MODEL 7600A

Dynamics Electronic Products

Division of Waugh Controls Corporation

DYNAMICS

OPERATING INSTRUCTIONS
for
UNIVERSAL AMPLIFIER
MODEL 7600A

SALES NO: C787740

PART NO: 400171

MODEL NO: 7600A

DYNAMICS
DIV. OF WAUGH CONTROLS CORP.
9001 FULLBRIGHT AVENUE • CHATSWORTH • CALIFORNIA 91311 • (213) 998-0121 • TLX 69-6171

Waugh Controls

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SECTION I: GENERAL INFORMATION

1.1 GENERAL

This manual contains installation, operation and maintenance procedures for the DYNAMICS Model 7600A Differential Dc Amplifier Signal Conditioning System. The instrument is designed and manufactured by the DYNAMICS Division of WAUGH Controls Corporation, Chatsworth, California.

The Dynamics Model 7600A Signal Conditioning System contains an electronically coupled, solid-state amplifier for general purpose instrumentation applications. Its input circuit is a symmetrical, true-differential configuration that is designed to accommodate a variety of resistance transducers including strain gauges, RTDs and potentiometers.

The module is 8.75" (22.25 cm) high, 1.75" (4.45 cm) wide and 18" (45.72 cm) deep. Up to ten modules can be mounted in a 10-channel cabinet, Model 7914R. A single-channel cabinet, Model 7914D, is also available. Operating channels are supplied by an integral power supply within each amplifier.

Special features of the Model 7600A are listed in Section 1.2. Available options are described in Section 1.3. Installation, operation, principles of operation, and maintenance instructions are provided in subsequent manual sections.

1.2 FUNCTIONAL FEATURES

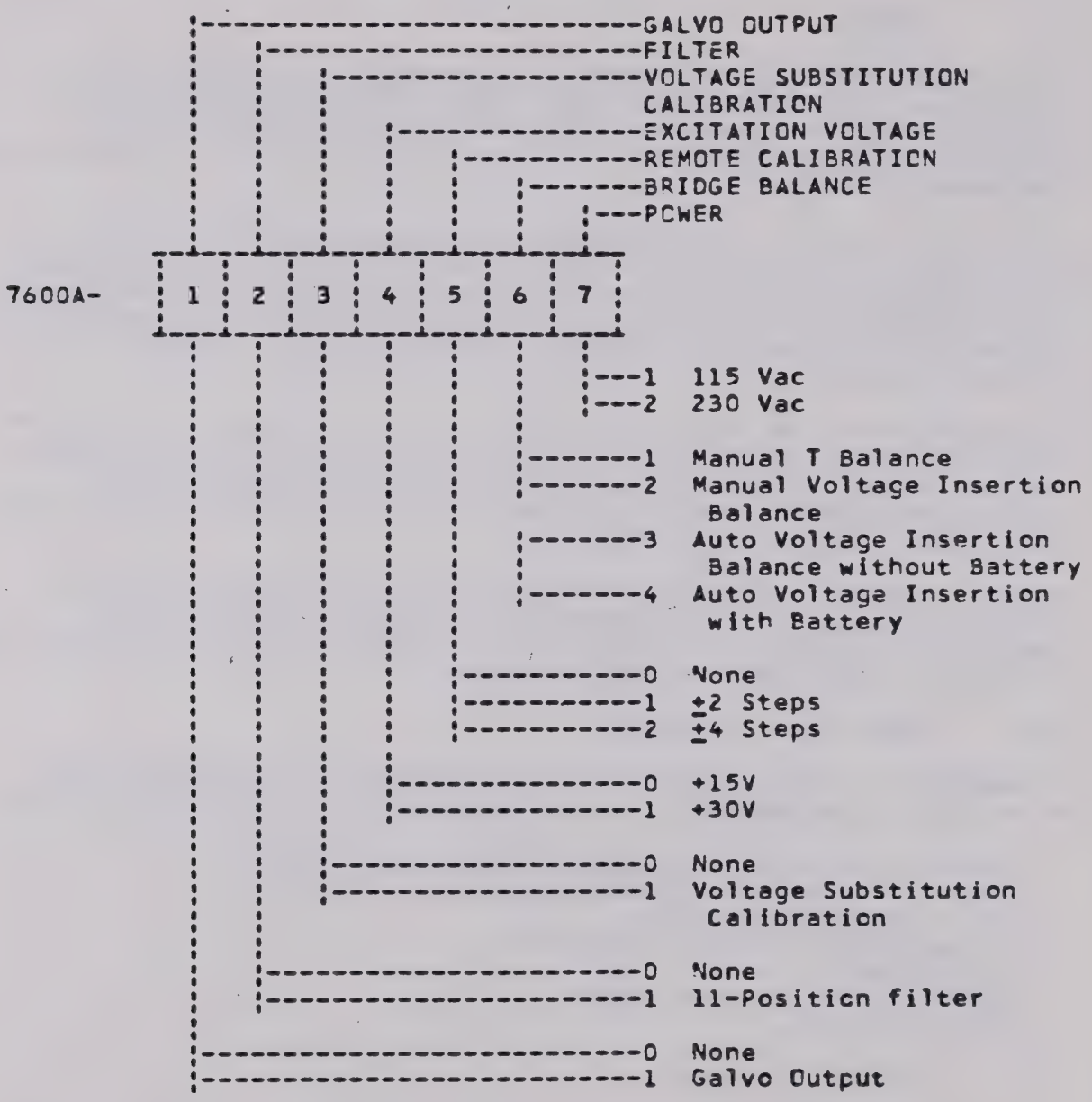
In addition to the specific functions performed, the instrument offers some outstanding built-in features. These features include:

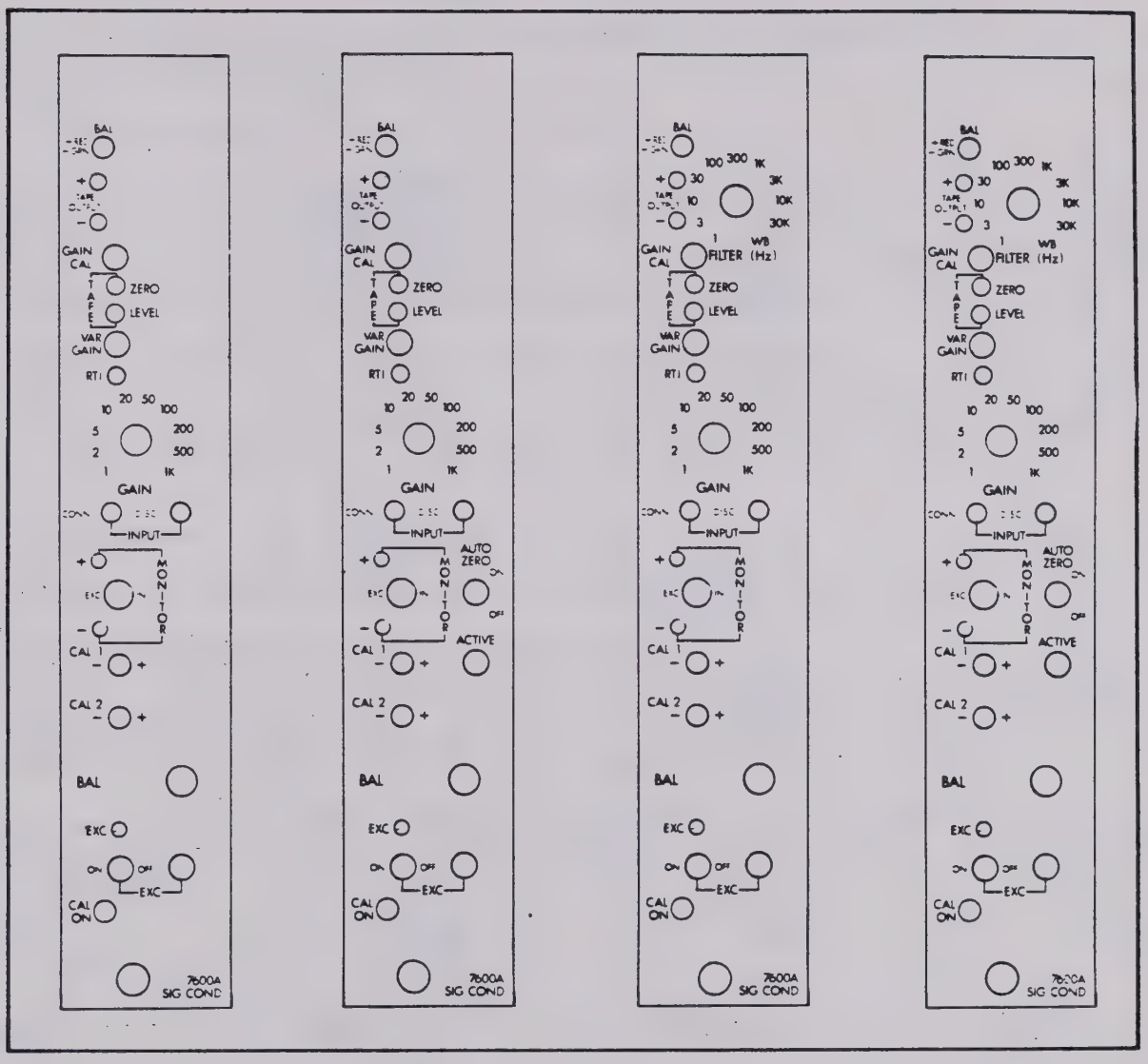
- Plus or minus 50V common-mode operating range.
- Constant-current or constant-voltage excitation.
- Fast overload recovery.
- Output short-circuit protected.
- Low noise.
- Self-contained power supply.
- Socketed IC's.

1.3 OPTIONAL FEATURES

The Model 7600A may be ordered with a choice of options specified at the time of purchase. Model designation suffixes are determined by the selected options as shown in Table 1-1. Front panels for the various models are illustrated in Figures 1-1 and 1-2. Options are described in the following text.

Table 1-1 Model 7600A Designations

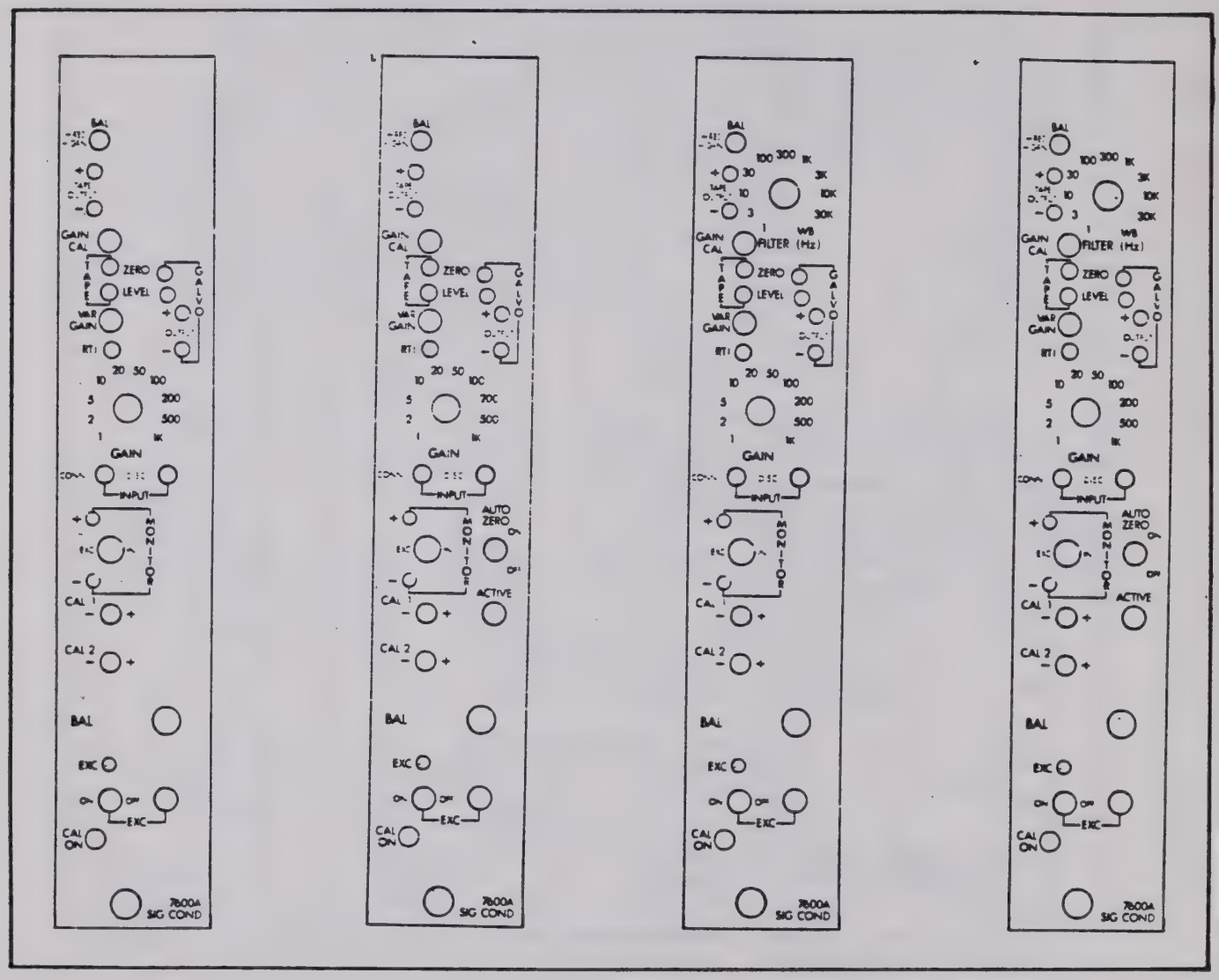




(A) (B) (C) (D)

Figure 1-1 Model 7600A Front Panels

(A) Model 7600A-00-XXX1-X or 7600A-00-XXX2-X
(B) Model 7600A-00-XXX3-X or 7600A-00-XXX4-X
(C) Model 7600A-01-XXX1-X or 7600A-01-XXX2-X
(D) Model 7600A-01-XXX3-X or 7600A-01-XXX4-X



(A) (B) (C) (D)

Figure 1-2 Model 7600A Front Panels

(A) Model 7600A-10-XXX1-X or 7600A-10-XXX2-X
(B) Model 7600A-10-XXX3-X or 7600A-10-XXX4-X
(C) Model 7600A-11-XXX1-X or 7600A-11-XXX2-X
(D) Model 7600A-11-XXX3-X or 7600A-11-XXX4-X

1.3.1 Feature 1 - Galvo Output

A non-required feature which when selected, conditions the amplifier for a galvanometer output.

1.3.2 Feature 2 - Electronic Filter

An optionally selected feature incorporated in an 11-position filter switch that can be connected to either or both outputs, or disconnected by internal jumper blocks. The switch selects a -3dB cutoff point from 1 Hz to a wideband (W.B.) position that makes the - 3 dB frequency well above the highest designated cutoff frequency.

1.3.3 Feature 3 - Voltage Substitution Calibration

Provides voltage substitution calibration. A guarded relay disconnects the amplifier input and connects it to a calibration source.

1.3.4 Feature 4 - Excitation Voltage

Provides an extended excitation voltage range to 30 volts.

1.3.5 Feature 5 - Remote Calibration

A non-required feature. When option 1 is selected, ±2 steps are supplied by relays. When option 2 is selected, ±4 steps are supplied by relays. (+24V to +28V supplied by user.)

When any of the remote calibration options are selected, a front panel LED is supplied. The LED is illuminated whenever a calibration is selected.

1.3.6 Feature 6 - Bridge Balance

Bridge balance is a required feature which enables the user to select from the following options:

1. Manual T Balance

2. Manual Voltage Insertion Balance

3. Automatic Voltage Insertion Balance without Battery

4. Automatic Voltage Insertion Balance with Battery

The Voltage Insertion Balance option provides an isolated power supply for true voltage injection balance at the amplifier input. A front panel control (with locking knob) provides voltage injection bridge balance.

With Automatic Bridge Balance the bridge is automatically balanced to zero from the front panel or by a remote input command. Front panel controls for Auto Bridge Balance include a 2-position toggle switch, a manual balance control and a LED indicator.

When Auto Bridge Balance with Battery Backup is selected, a Ni-Cad battery which "remembers" the zero value (during power off) is provided on the board.

1.3.7 Feature 7 - Power

This is a required feature which provides an optional selection for operation at either 115 or 230 Vac.

1.4 CHARACTERISTICS AND SPECIFICATIONS

Performance characteristics and specifications of the DYNAMICS Model 7600A Differential Dc Amplifier Signal Conditioning System are listed in Table 1-2, and leading particulars are given in Table 1-3.

Table 1-2 Performance Characteristics

PARAMETER	CHARACTERISTICS
I. DIFFERENTIAL DC AMPLIFIER	
A. Input	
1. Input Impedance	25 Megohm shunted by 500 pF
2. Source Impedance	Specifications met with up to a source impedance of 1 kohm. (10 kohm operation permitted.)
3. Overscale Input	±30 Vdc, or peak ac without damage.
4. Input Bias Current ...	<2.0 nA at 25 °C <0.5 nA/°C
B. Tape Output (Standard)	
1. Output Capability	±10V at 5 mA, limited to ±15V at 25 mA. Short-circuit protected.
2. Capacitive Loading ...	Up to 0.1 uF, no instability
3. Output Impedance	1.0 ohm in series with 20 uH.
4. Output Level	Adjustable from 0V to ±10V
5. Output Zero Control	
a) Adjustment Range ..	±40 mV
b) Resolution	±0.5 mV
C. Galvo Output (Optional)	
1. Output Capability	±10V at 100 mA limited to ±15V at 150 mA
2. Current Limiting	Adjustable from ±20 mA or ±120 mA
3. Output Impedance	0.5 ohm in series with 5 uH.
4. Output Level	Adjustable from 0V to ±10V
5. Output Zero Control	
a) Adjustment Range ..	-10 Vdc to +10 Vdc
b) Resolution	±1 mV @ 0V, and ±20 mV @ ±10V Output

Table 1-2 (Continued)

D. Outputs (General)

1. Polarity ..... Same for Tape and Galvo outputs

2. Isolation ..... One output may be shorted with <0.025% effect upon the other

3. Zero Indicator ..... LED indicates the tape output zero status:
(a) Red if output is positive
(b) Green if output is negative
(c) Off if output is within 1.0mV of zero.

(Does not include effects of the Galvo Output Zero Control)

E. Ac

(All ac specifications are independent of gain steps or variable gain settings)

1. Frequency Response ... ±1% (dc to 10 kHz)
±1 dB (10 kHz to 50 kHz)
-3 dB (above 100 kHz)

2. Settling Time ..... <25 us to 0.1% of final value

3. Overload Recovery Time ..... <50 us to 5% of full scale for any overload up to 10 times full-scale input not exceeding ±20 Vdc or peak ac

4. Slewing Rate ..... 3.7 V/us, 20V p-p output to 60 kHz

5. Noise .....

RTI	Bandwith
5.0 uV rms	0.1 Hz to 100 kHz
3.0 uV rms	0.1 Hz to 50 kHz
2.0 uV rms	0.1 Hz to 10 kHz
4.0 uV p-p	0.1 Hz to 100 Hz
1.0 uV p-p	0.1 Hz to 10 Hz
+200 uV rms	RTO

Table 1-2 (Continued)

F. Dc

1. Zero Drift (Constant Temp.) .... ±2 uV RTI, ±200 uV RTO
±200 uV/V (output offset)/8 hours after 1/2 hour warmup

2. Temperature Coefficient of Drift ..... ±0.5 uV/°C RTI, ±100 uV/°C RTO
±100 uV/V/°C of output offset

3. Linearity ..... ±0.005% of full Scale at dc.

4. Gain Accuracy ..... ±0.1% in calibrate position of the CAL switch

5. Gain Stability ..... ±0.005%/200 hours, ±0.005%/°C

6. Zero Range ..... ±100 uV RTI of zero adjustment
RTO set by output controls

G. Common-Mode
1. Rejection Ratio .....

	SOURCE IMPEDANCE	
Gain	0 Ohm	350 Ohm
1000	126 dB	120 dB
100	106 dB	100 dB
10	86 dB	80 d3
1	66 dB	66 dB

For common-mode frequencies from dc to 60 Hz, CMRR decreases at a rate of 6 dB/Octave above 60 Hz.
Limited to 60 dB at a gain of 1000, for frequencies up to 100 MHz.

2. Operating Level ..... ±50 Vdc from dc to 60 Hz.
Decreases at a rate of 6 dB/octave above 1 kHz.
Limited to 1V p-p up to 100 MHz.

3. Overscale ..... ±75 Vdc or peak ac without damage.

4. Input Impedance ..... 2000 Mohm shunted by 1.5 pF.

Table 1-2 (Continued)

II SIGNAL CONDITIONER

Excitation Power Supply

	Constant Voltage Standard Output	Constant Voltage (High Volt.Option)	Constant Current
Excitation	0.1 to 15V at 100 mA. Constant current or constant voltage selected by jumpers on bridge completion card. Short circuit current limited to 160 mA.	0.1 to 30V at 75 mA. Constant current or constant voltage selected by jumpers on bridge completion card. Short circuit current limited to 160 mA.	1 mA to 100 mA. Compliance voltage is 0.1V to 15V. At 0 to 75 mA and 0.1V to 13V at 75 to 100 mA. Constant current or constant voltage selected by jumpers on bridge completion card.
Resolution	Recessed front panel control has setability of 8.5 mV.	Recessed front panel control has setability of 17 mV.	Recessed front panel control has setability of 60 uA.
Line Regulation	0.005% or 150 uV whichever is greater for plus or minus 10% line variations.	0.005% or 300 uV whichever is greater for plus or minus 10% line variations.	0.005% or 1.0 uA whichever is greater for plus or minus 10% line variations.
Load Regulation	150 uV plus 100 uV/ohm of lead resistance limited to 5 ohm independent of the excitation voltage. Sense current is less than 100 uA. The output does not overvoltage with the sense leads disconnected. Local sense may be selected on the completion card.	300 uV plus 100 uV/ohm of lead resistance limited to 5 ohm independent of the excitation voltage. Sense current is less than 100 uA. The output does not overvoltage with the sense leads disconnected. Local sense may be selected on the completion card.	Less than 0.005% or 1.0 uA whichever is a greater change in output current for a 10 to 1 change in compliance voltage.

Output Impedance	0.01 ohm in series with 20 uH	0.01 ohm in series with 20 uH	10 Mohm in parallel with 300 pF.
Noise	150 uV p-p from 0.1 Hz to 20 kHz.	300 uV p-p from 0.1 Hz to 20 kHz.	1 uA p-p from 0.1 Hz to 20 kHz with a 350 ohm bridge.
Stability	0.01% or 500 uV per 8 hours after 30 minute warm-up	0.01% or 1 mV per 8 hours after 30 minute warm-up	0.01% or 1.5 uA per 8 hours after 30 minute warm-up
Temperature Coefficient	0.005%/°C or 100 uV/°C whichever is greater.	0.005%/°C or 200 uV/°C whichever is greater.	0.005%/°C or 0.5 uA/°C whichever is greater.

Table 1-3 Leading Particulars

ITEM	CHARACTERISTICS
Identification	Model 7600A
Type	Differential Dc Amplifier Signal Conditioning System
Enclosure	Plugs into 10-channel cabinet, Model 7914R/NR or Single-Channel cabinet, Model 7914D/NR.
Dimensions	
Width	1.75 in. (4.45 cm)
Height	8.75 in. (22.25 cm)
Depth	18 in. (45.72 cm)
Weight	Approximately 7 lb. (3.18 kg)
Power Requirements	
Ac Input	(-1) 100 to 125 Vrms, 47 to 63 Hz (-2) 200 to 250 Vrms, 47 to 63 Hz
Power Consumption	15W maximum
Fuse	Internal in Amplifier
Environment	
Temperature Range	
Operating	+32 to +122 °F (0 to +50 °C)
Storage	-4 to +167 °F (-20 to +70 °C)
Humidity	Up to 90% relative humidity without condensation.

NOTES

SECTION II: INSTALLATION PROCEDURES

2.1 GENERAL

This section contains unpacking and installation instructions for the DYNAMICS Model 7600A Differential Dc Amplifier Signal Conditioning System.

2.2 RECEIVING INSPECTION

The Model 7600A instrument is fully assembled and operationally checked prior to shipment from the factory. The unit is packaged in accordance with standard practices for electronics instrumentation equipment. Every precaution is taken to ensure that all instruments leaving the factory are complete and ready for installation. However, it is recommended that each unit be inspected upon receipt, for in-transit damage.

Prior to opening the container, inspect the shipping container for evidence of in-transit damage such as being dropped, crushed, or punctured. Contact the carrier and manufacturer immediately if damage is evident specifying the nature and extent of damage. Open the shipping container and remove its contents only if there is no apparent shipping damage. Check items removed from the shipping container against the shipping list to verify container contents. Contact the manufacturer immediately if a packing shortage is determined.

Remove the protective padding and covering from the system units. Verify that the serial number of each unit corresponds to that shown on the shipping invoice. Inspect the exterior of each enclosure for evidence of physical damage which may have occurred during shipment. Tighten any loose screws or mounting hardware as required.

As soon as the instrument is unpacked, verify that all switches have positive action and that all variable controls on the front action, and that all variable controls on the front panel can be turned through their full range without binding.

The Model 7600A may be installed upon completion of the receiving inspection. Contact the manufacturer or manufacturer's service representative if inspection reveals any major discrepancies.

2.3 INSTALLATION REQUIREMENTS

Power, space and interface requirements are the primary concern in installing the system. The amplifier should be located in a well ventilated area with normal ambient temperature and minimum vibration.

****
* CAUTION *
****

The amplifier is designed to operate in an ambient temperature between 32 to 122 °F (0 to 50 °C). The outside of the chassis should be kept free of accumulated moisture to prevent the formation of unwanted ground paths. If operated in a dusty environment, the front panel should be kept free of dust. Air for cooling is drawn in through an opening below the amplifier near the front of the cabinet.

2.4 INSTALLATION

The Model 7600A instrument is contained in a 1.75" x 8.75" x 18" housing which provides protection for the electronics. Up to 10 Differential Amplifiers may be mounted in an optional cabinet. Refer to Figure 2-1 for the following installation procedure.

****
* NOTE *
****

The Model 7600A may be mounted in a Model 7914AR/VX or Model 7914AR/VX-2 10-channel cabinet, or a Model 7914AD/VX Single-Channel cabinet.

The plug-in instrument has a knurled knob on the bottom of its front panel that locks the unit into the cabinet. To install, turn the knob counter-clockwise, then slide the unit into the cabinet (as shown in Figure 2-1) until the connector on the module engages the connector in the cabinet. Lock the unit in the cabinet by turning the knob fully clockwise.

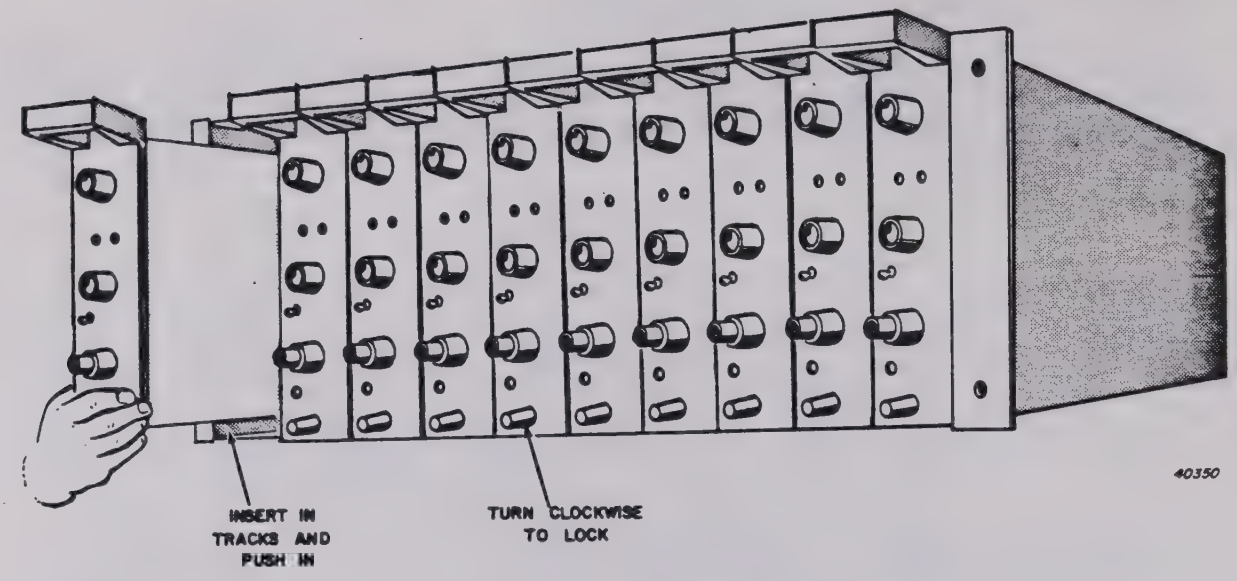


Figure 2-1. Installing the Model 7600A

2.5 FIELD WIRING

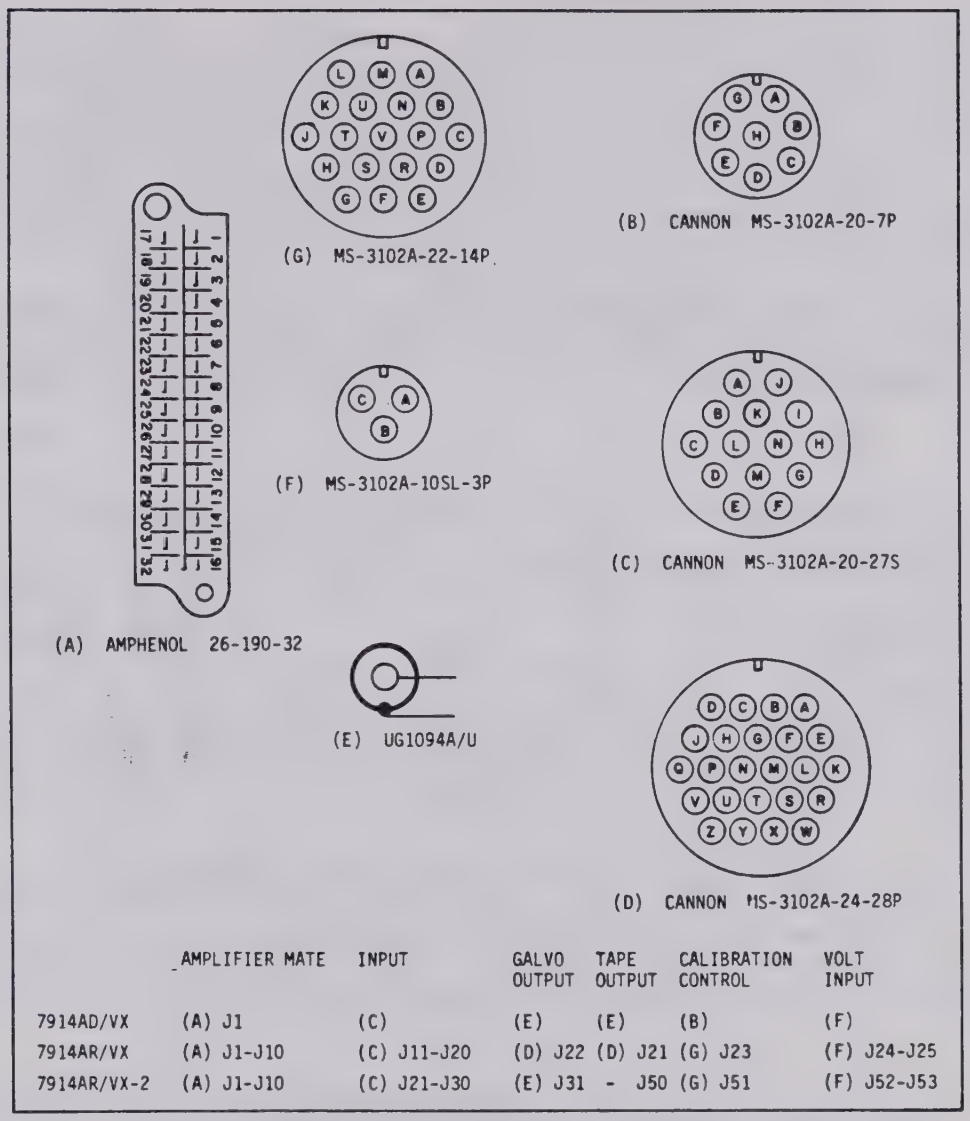
Field connections are wired to "Cannon" plugs (not supplied) which are mated with appropriate "Cannon" connectors at the rear of Dynamics standard model cabinets. Wiring information for this purpose is provided in Table 2-1. The table defines connector functions, types of connectors and cabinet models. Connector pins are defined in Figure 2-2.

Table 2-1 Input/Output Connections To 7600A

DESCRIPTION		PIN DESIGNATION		
FUNCTION	DES.	7914AR/VX	7914AR/VX-2	7914AD/VX
INPUT CONNECTOR		MS3102A-20-27S	MS3102A-20-27S	MS3102A-20-27S
-INPUT	-IN	A	A	A
+INPUT	+IN	B	B	B
GUARD SHIELD	GS	C	C	C
+INPUT CAL	+IC	D	D	D
-INPUT CAL	-IC	E	E	E
+POWER CAL	+PC	F	F	F
-POWER CAL	-PC	G	G	G
GUARD SHIELD	GS	H	H	H
+SENSE	+S	I	I	I
-SENSE	-S	J	J	J
-EXCITATION	-E	K	K	K
+EXCITATION	+E	L	L	L
GUARD SHIELD	GS	M	M	M
CALIBRATION		MS3102A-22-14P	MS3102A-22-14P	MS3102A-20-7P
+28V		A	A	A
+28V Return		B	B	B
CAL 1 Control		C	C	C
CAL 2 Control		D	D	D
Auto Zero Control		E	E	E
CAL 3 Control		F	F	F
CAL 4 Control		G	G	G
CAL Reverse		H	H	H
Voltage Subst. CAL		J	J	
Channel 1 Select		K	K	
Channel 2 Select		L	L	
Channel 3 Select		M	M	
Channel 4 Select		N	N	
Channel 5 Select		P	P	
Channel 6 Select		R	R	
Channel 7 Select		S	S	
Channel 8 Select		T	T	
Channel 9 Select		U	U	
Channel 10 Select		V	V	
Voltage Subst Input		MS3102A-10SL-3P	MS3102-10SL-3P	MS3102A-10SL-3P
+Input		A	A	A
-Input		B	B	B
Shield		C	C	C

Table 2-1 Continued:

TAPE/GALVO OUTPUTS		MS3102A-24-28P	UG1094A/U(BNC)	UG109A/V(BNC)
CHANNEL	FUNCTION			
1	Signal	A	Center pin is the signal and the shell is the return.	Center pin is the signal and the shell is the return.
1	Return	B		
2	Signal	C		
2	Return	D		
3	Signal	E		
3	Return	F		
4	Signal	G		
4	Return	H		
5	Signal	J		
5	Return	K		
6	Signal	L		
6	Return	M		
7	Signal	N		
7	Return	P		
8	Signal	Q		
8	Return	R		
9	Signal	S		
9	Return	T		
10	Signal	U		
10	Return	V		



	AMPLIFIER MATE	INPUT	GALVO OUTPUT	TAPE OUTPUT	CALIBRATION CONTROL	VOLT INPUT
7914AD/VX	(A) J1	(C)	(E)	(E)	(B)	(F)
7914AR/VX	(A) J1-J10	(C) J11-J20	(D) J22	(D) J21	(G) J23	(F) J24-J25
7914AR/VX-2	(A) J1-J10	(C) J21-J30	(E) J31 - J50		(G) J51	(F) J52-J53

A - Used for J1 thru J10 on 7914R/VX (Also used in 7914D/VX)
B - Used for J23 on 7914R/VX (Also used in 7914D/VX)
C - Used for J21, J22 on 7914RVX (Only)
D - Used for J11 thru J20 on 7914R/VX (Also used in 7914/VX)
E - Used for Tape and Galvo Outputs in 7914D/VX only.

Figure 2-2. Connectors Used on Cabinets

2.5.1 Ten-Channel Cabinets

2.5.1.1

The Model 7914AR/VX, 10-channel cabinet has 10 input connectors (one for each channel), two output connectors (one each for Tape and Galvo outputs), a single connector for calibration adjustments plus, a line fuse. The rear panel showing all connectors is illustrated in Figure 2-3. The input channel connectors are 14-pin type MS3102-2C-27S, the output connectors are 24-pin type MS3102A-24-28P, the calibrate connector is a 19-pin Cannon type MS3102A-22-14P and two voltage substitution connectors which are wired in parallel to allow daisy chaining cabinets and are 3-pin type MS3102A-10SL-3P.

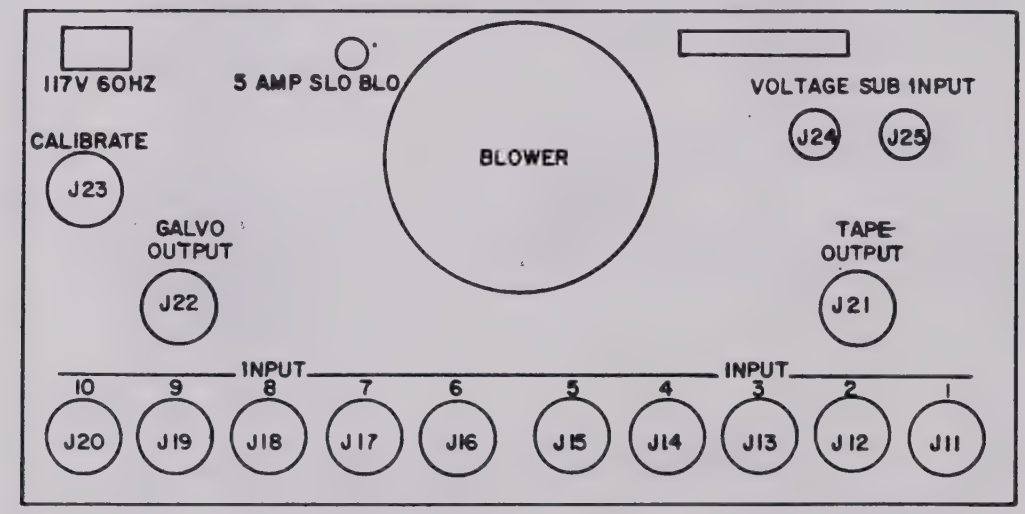


Figure 2-3. Model 7914R/VX Rear Panel

2.5.1.2

Model 7914AR/VX-2 is the same as the Model 7914AR/VX except the common tape and galvo outputs have been changed to individual BNC connects. Figure 2-4 shows the rear panel.

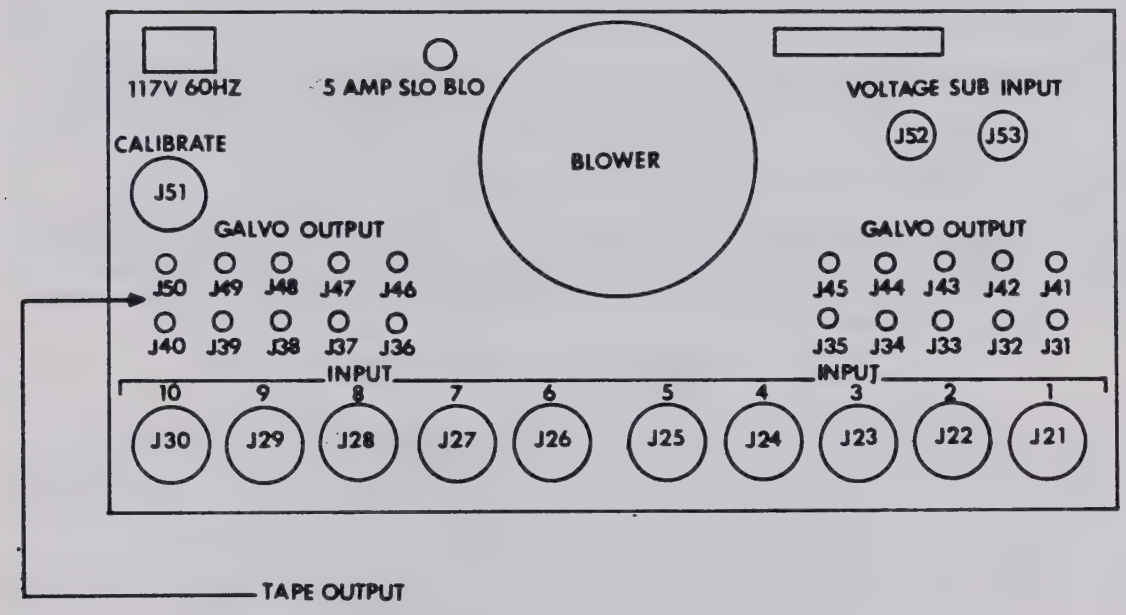


Figure 2-4. Model 7914AR/VX-2

2.5.2 Single-Channel Cabinet

The Model 7914AD/VX Single-Channel Cabinet has separate connectors for input, tape output, galvo output, plus a power switch and line fuse. A front panel showing all connectors is illustrated in Figure 2-5. The input connector is a 14-pin type MS3102A-20-27S, the calibrate connector is an 8-pin type MS3102A-20-7P, and the output connectors (Tape and Galvo) are BNC type UG 1094A/U and the voltage substitution connector is type MS3102A-105L-3P.

2.5.3 Input Considerations

Each amplifier module is completely isolated from all other amplifiers in the 10-channel cabinet. The 7600A is designed for maximum isolation which provides a high common-mode rejection characteristic with a high signal-to-noise ratio.

Special care must be taken with the input cabling to minimize external hum pickup and thermal effects. This is absolutely necessary if the amplifier's low internal noise figure and zero error are to be realized.

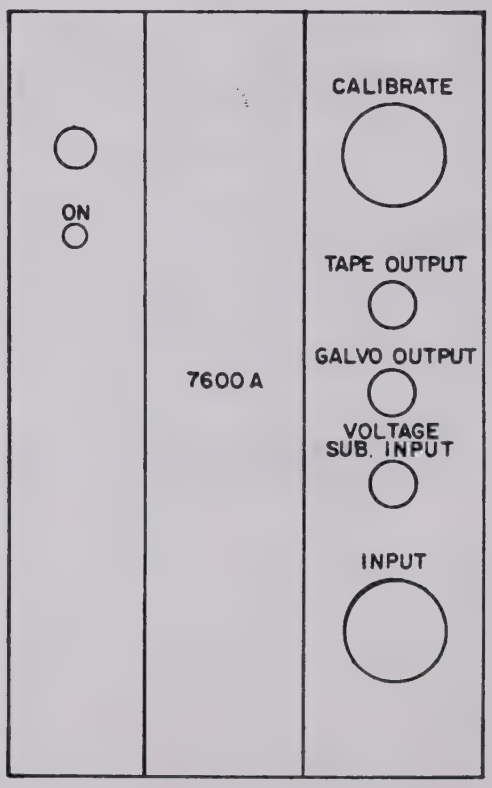


Figure 2-5. Model 7914AD/VX Front Panel

2.6 MOUNTING COMPONENTS ON BRIDGE COMPLETION CARD

Provision is made on the Bridge Completion Card for mounting up to eight bridge completion resistors and up to 16 calibration resistors. Required resistors may be separately mounted for a fixed configuration. However, if the user intends to change the configuration often, the card is pre-wired for mounting DIP switches (not supplied.)

System configuration is further simplified by making alternative jumper connections available when selecting a configuration. The user may optionally elect to install wire-wrap headers for use with standard wire-wrap jumper blocks to make the necessary electrical connections. Cards may be reconfigured from application to application in a minimum amount of time.

This section describes installation methods for mounting the various types of components listed above. Procedures for calculation and selection of appropriate resistors for system configuration is made part of the operating procedures since the configuration must be completed before operation of the system may begin.

2.6.1 Bridge Completion Card Removal

It is necessary to remove the Bridge Completion Card from the mother board before installing components. The Bridge Completion Card can be accessed by removing the right side cover as looking at the front panel. The cover can be removed by removing the screw located at the rear of the cover and sliding the cover towards the rear until it clears the Bridge Completion Card. To remove, grasp the board firmly using thumbs and forefingers extending across each corner, and lift up using a gentle rocking motion.

****
* CAUTION *
****

There are a total of 95 wire-wrap contacts on all four sides of the board so that heavy resistance may be encountered in lifting.

2.6.2 Resistor Installation

Locations for direct insertion of bridge completion and calibration resistors are designated in the imprinted silkscreen on the Bridge Completion Card. Resistor locations are highlighted in the component side illustration of Figure 2-6.

****
* NOTE *
****

Calibration resistor designations correlate to bridge completion resistor designations. e.g. -R1A and +P1A calibration resistors would be used in conjunction with R1A bridge completion resistor.

Insert axial leads of resistors in appropriate holes provided for this purpose. Solder the leads on the circuit side and cut off excess lead length. Standard practices in the electronic industry should be observed in soldering system components.

****
* CAUTION *
****

Resistors should be laid flat on the board to avoid interference when the module is inserted in the cabinet. Maximum component height is 0.375 in.

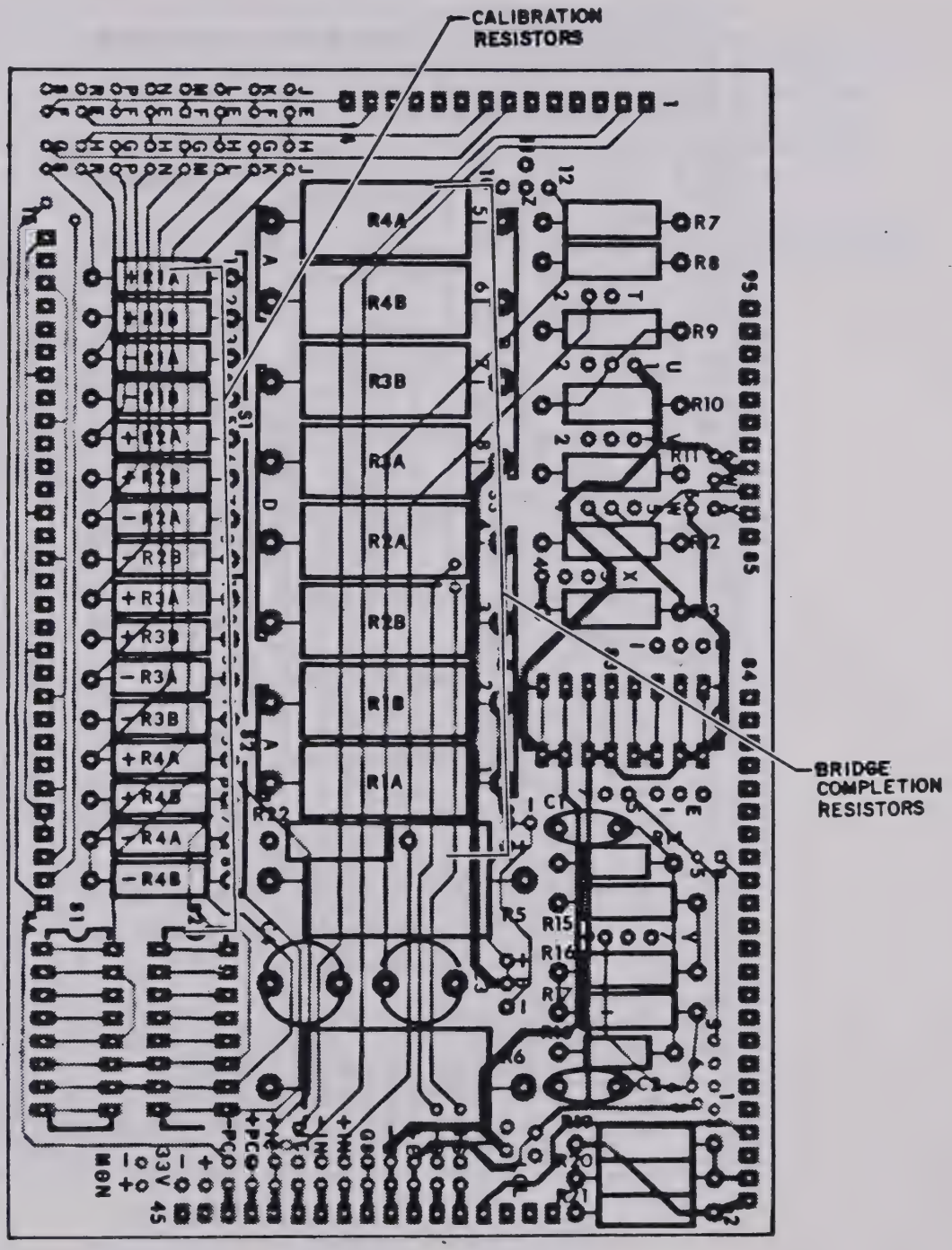


Figure 2-6. Bridge and Calibration Resistor Locations

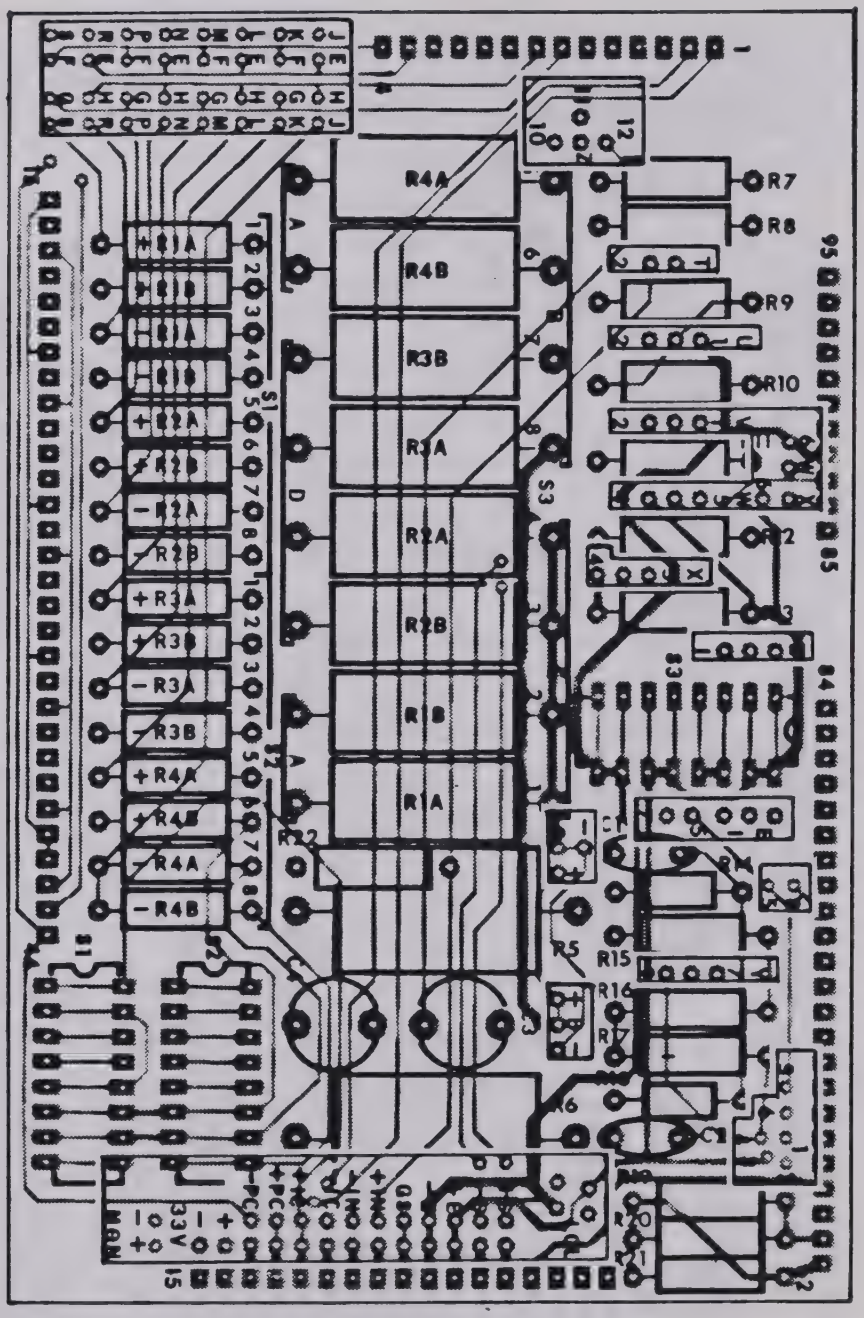


Figure 2-7. Header Locations

2.6.3 Wire-Wrap Header Installation

For rapid reconfiguration, wire-wrap headers may be installed in all jumper locations as indicated in Figure 2-7. Samtec Electronic Hardware Co. headers, part number TSW-136-09-G-S for single row and TSW-136-09-G-D for double row are recommended for this purpose. The headers come with 36 contacts but may be easily trimmed to the desired number of contacts with a pair of wire cutters.

Insert header pins from the circuit side and solder on the component side as shown in Figure 2-8. Cut excess leads on the circuit side after soldering.

****
* NOTE *
****

Holes are provided for header installation and are spaced so that they will accept standard jumper blocks for configuration. Berg wire-wrap jumper blocks, part number 65474-004 are recommended for this purpose.

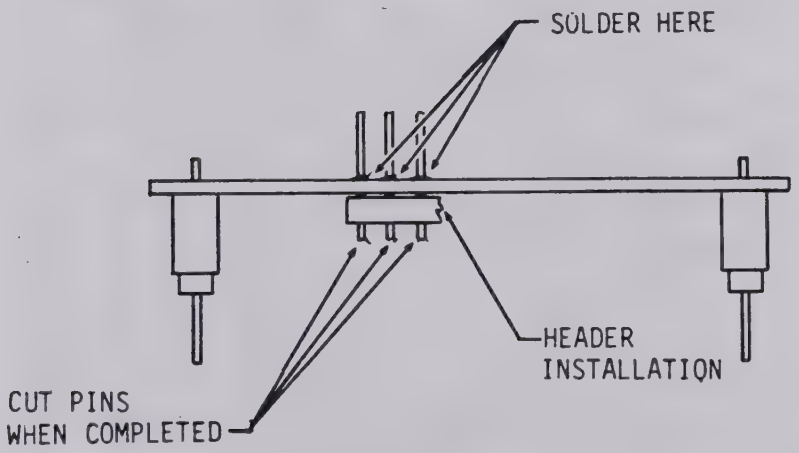


Figure 2-8. Wire-Wrap Header Installation

2.6.4 DIP Switch Installation

Provision is made for installation of three 8-position DIP Switches (designated as S1, S2 and S3) on the Bridge Completion Board. These locations are indicated in Figure 2-9. The switches are used for for rapid insertion (or deletion) of up to eight bridge completion resistors (S3) and up to 16 calibration resistors (S1 and S2). Switches and their related resistors are illustrated in the partial schematic of Figure 2-10.

To install DIP switches, proceed as follows:

1. Sever traces on the component side between all switch insertion holes. This step is necessary to ensure proper switch operation.

2. Insert switches from component side observing designated keyway.

3. Solder all switch pins on circuit side of the card.

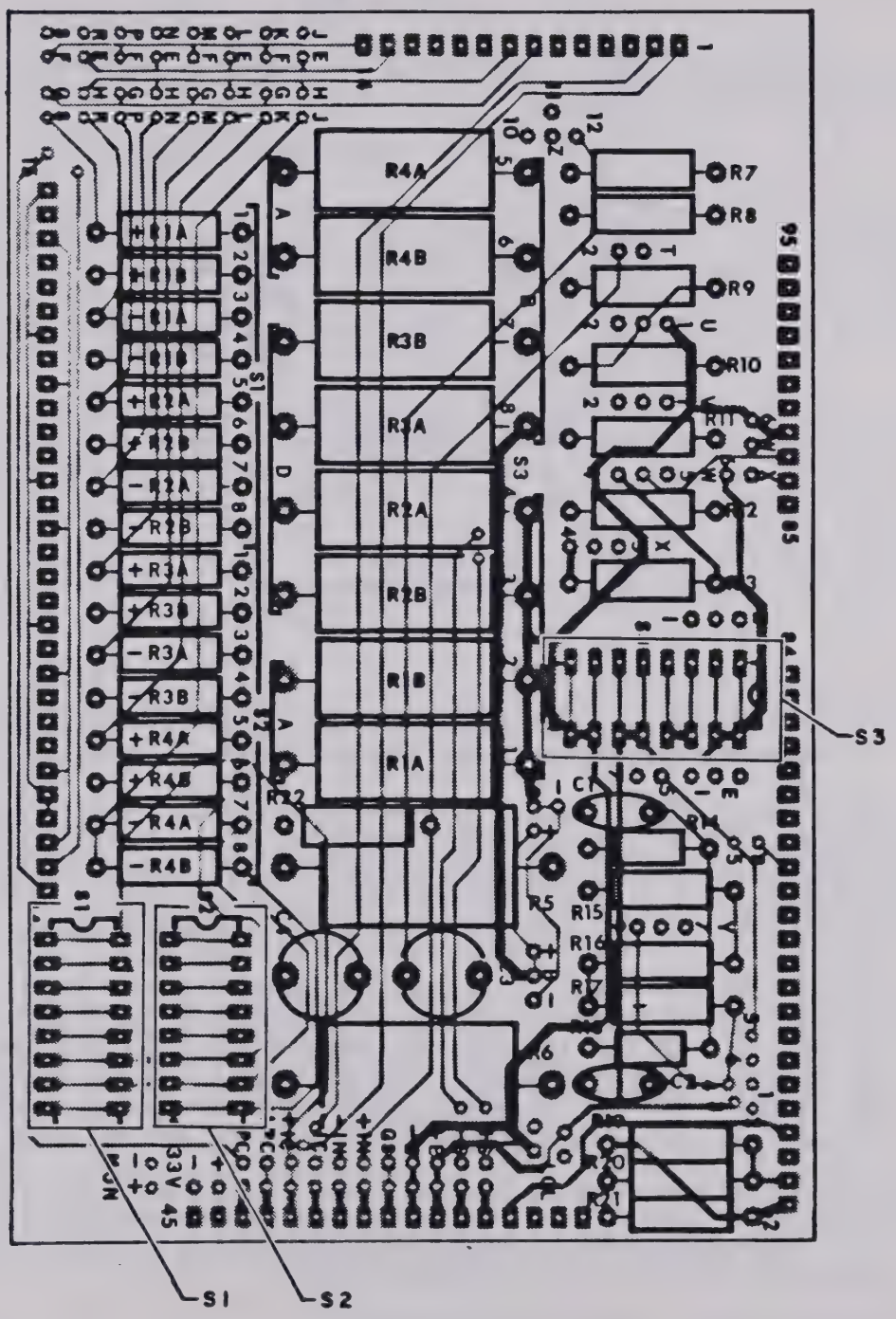
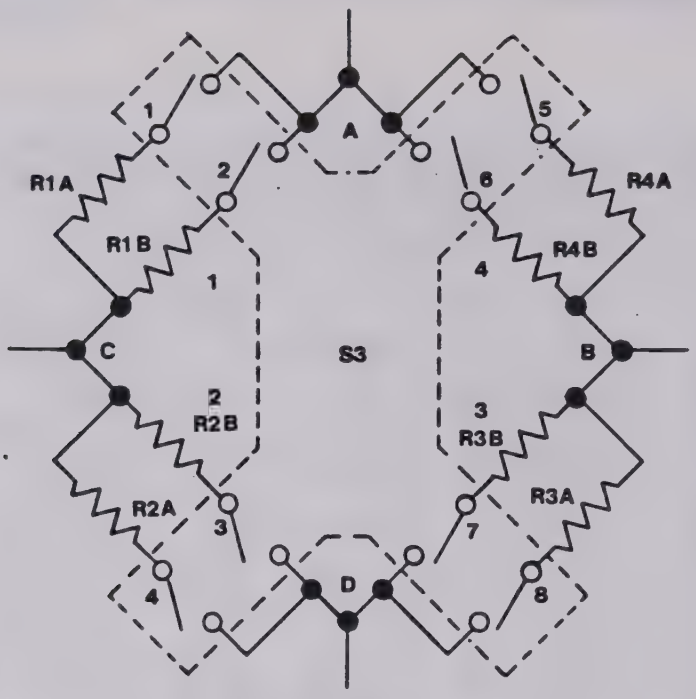
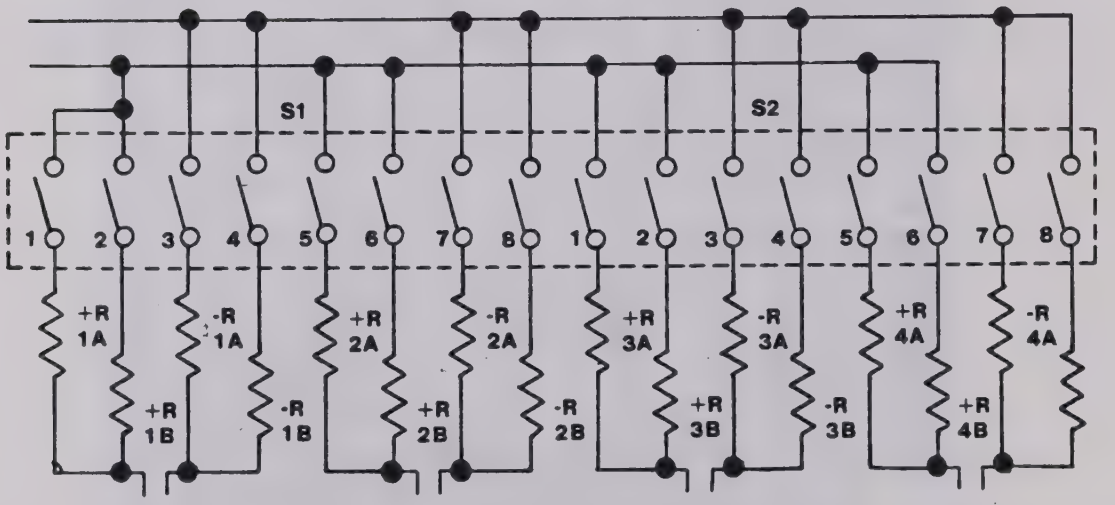


Figure 2-9. Switch Locations



(A) Bridge Completion Resistors



(B) Calibration Resistors
Switches shown within dashed boxes.

Figure 2-10. DIP Switch Wiring

SECTION III: OPERATING INSTRUCTIONS

3.1 GENERAL

This section provides general operating instructions for the DYNAMICS Model 7600A Differential Dc Amplifier Signal Conditioner.

3.2 CONTROL IDENTIFICATION

All operating controls and adjustment potentiometers used during normal operation are located on the front panel. Adjustments for input bias current and zero balance are located within the unit, set at the factory and should not require readjustment unless repairs are made to the instrument. The number and function of the controls for the various models depend upon the options included.

Front panels for different models are shown in Figure 1-1. Operation of the controls are the same for the different models, thus it is only necessary to describe them for only one model. Since Model 7600A-11-XXX3-X~ contains all controls used in the various models this will be the one described. Figure 3-1 shows the Model 7600A-11-XXX3-X~ (~ X signifies option for the appropriate feature. See Table 1-1.) front panel. A detailed explanation of the various controls is given in Table 3-1.

3.3 OPERATION

Once the 7600A has been installed and checked out (as described in Section II), the system is ready for operation.

The Model 7600A Signal Conditioning System is designed to accommodate a variety of resistance transducers; including strain gages, RTD's and potentiometers. Prior to operation with any of these transducers, the system must be configured and wired to make it compatible to the type of sensor or transducer used.

Configuration Requirements

1. Connect the transducer to appropriate input connector pins.
2. Select bridge-completion resistors.
3. Select calibration circuit and calibration resistors.
4. Select constant current or constant voltage operation.
5. Select remote or local excitation sensing.

Procedures for connecting the transducer and selecting the appropriate bridge-completion resistors are described in Section 3.4. The other items are described in subsequent sections.

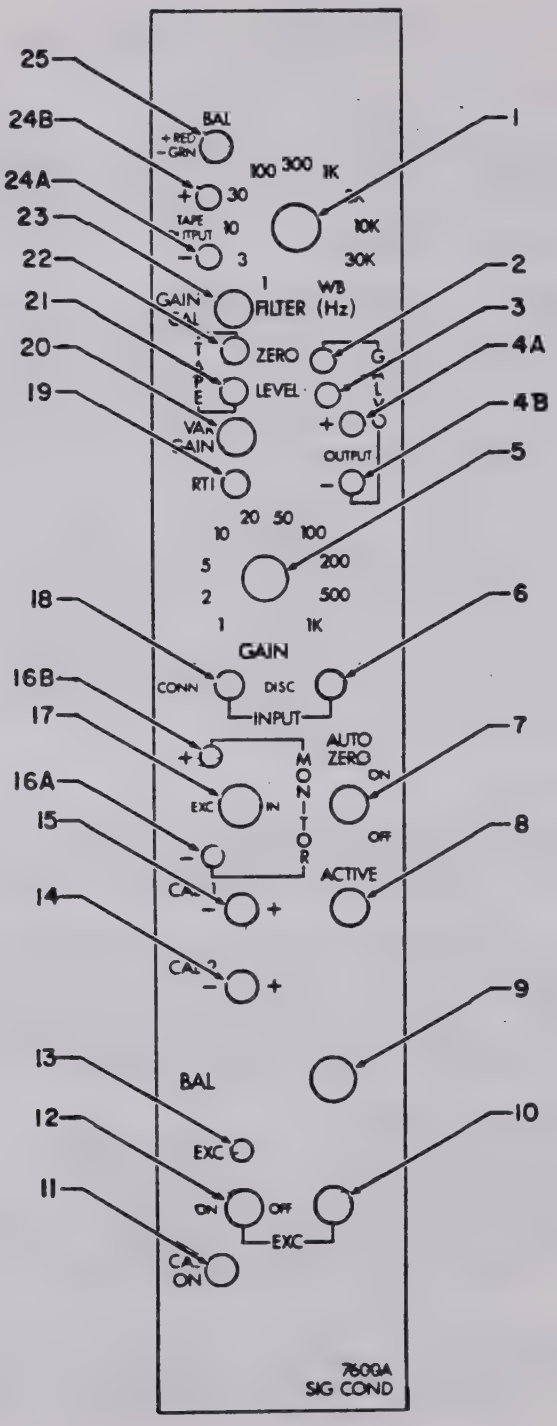


Figure 3-1 Controls, Indicators, and Front Panel Adjustments

Table 3-1 Control and Adjustment Identification
Model 7600A-11-XXX3-X~

ITEM	TITLE	DESCRIPTION
1	FILTER (Switch)	The FILTER switch is used to select cutoff (-3 dB) frequencies of the filter. This switch has 11 position including a W.B. (wideband) position that makes the -3 dB frequency well above the highest designated frequency. Cutoff frequencies (in Hz) are 1, 3, 10, 30, 100, 300, 1k, 3k, 10k, and 30k.
2	GALVO ZERO (Control)	A recessed, screwdriver-operated adjustment potentiometer. It permits adjustment of the zero level of the GALVO output over a range of ±10V.
3	GALVO LEVEL (Control)	A recessed, screwdriver-operated adjustment potentiometer. It is used to adjust the GALVO output from zero to 100% of full scale.
4	GALVO OUTPUT (Terminals)	Two front-panel pin jacks provided to monitor the output from the GALVO Amplifier.
5	GAIN (Switch)	An 11-position switch which provides fixed, selectable gain steps of 1, 2, 5, 10, 20, 50, 100, 200, 500, and 1000. A variable GAIN Control (Item 20) multiplies these switch settings over a continucus range between 1 and 2.5.
6	INPUT DISC (Indicator)	A lighted lamp indicates that the INPUT switch (Item 18) is in the disconnect (DISC) position.

X may be any option for the appropriate feature. See Table 1-1.

Table 3-1 (Continued)

ITEM	TITLE	DESCRIPTION
7	AUTO/ZERO (Switch)	2-position toggle switch used to turn the AUTO/BALANCE circuit on or off. In the OFF position the circuit is placed in the center of its range. Switching from OFF to ON automatically resets the circuit and the AUTO/ZERO cycle is initiated. ACTIVE Indicator (Item 8) is lit during the AUTO/ZERO process.
8	ACTIVE (Indicator)	The Active LED is illuminated during the AUTO/ZERO process initiated by resetting the AUTO/ZERO Switch, (Item 7), from OFF to ON.
9	BAL (Control)	A potentiometer provides the means for bridge balance adjustment. It is equipped with an outer ring locking knob to prevent accidental movement of the BAL knob once the balance is set.
10	EXC (Indicator)	When lit, the LED indicates that the EXC Switch, (Item 12), is in the OFF (Disconnect) position.
11	CAL ON (Indicator)	When lit, the LED indicates that a remote calibration has been selected.
12	EXC (Switch)	When set to the right, the Excitation Disconnect Switch removes the plus (+) excitation voltage from the bridge and connects the plus bridge power to the minus (-) bridge power terminals. When Excitation is disconnected, EXC Indicator (Item 10) is illuminated.
13	EXC (Control)	A recessed screwdriver-operated adjustment potentiometer used to adjust the bridge excitation voltage (or current) to the desired value. The voltage may be monitored at the MONITOR Test Jacks, (Item 16).

Table 3-1 (Continued)

ITEM	TITLE	DESCRIPTION
14	CAL 2 (Switch)	A center-off, spring-loaded switch. It selects ±1 step. Any one of the four available calibration steps may be selected.
15	CAL 1 (Switch)	A center-off, spring-loaded, switch It selects ±1 step of calibration. Any one of the four available calibration steps may be selected.
16	MONITOR (Terminals)	Front-panel pin jacks that provide the monitoring points for bridge input and excitation voltages as selected by the MONITOR Switch (Item 17). The MONITOR terminals may be wired to an external bus for multi-channel systems.
17	EXC/IN (Switch)	2-position toggle switch to select the voltages that are to be connected to the MONITOR terminals, (Item 16). When set to the left, excitation voltage is connected; when set to the right, the amplifier input is connected.
18	INPUT DISC (Switch)	Set in the disconnect position, the input disc switch disconnects the input signal and shorts the amplifier input.
19	RTI (Control)	The Zero RTI control is a recessed screwdriver-operated adjustment. It is used to adjust the input stages to 0V. It has a range of ±100 uV RTI of zero adjustment.

Table 3-1 (Continued)

ITEM	TITLE	DESCRIPTION
20	VAR GAIN (Control)	A multi-turn variable control multiplies the fixed GAIN switch settings over a continuous range from unity (fully CCW) to 2.5 (fully CW). This control is disconnected from the circuit and the gain set to unity when the GAIN/CAL switch, (Item 23), is in the CAL position.
21	TAPE LEVEL (Control)	A recessed, screwdriver-operated adjustment potentiometer used to adjust the tape output from zero to 100% of full scale.
22	TAPE ZERO (Control)	A recessed, screwdriver-operated adjustment potentiometer that permits adjustment of the zero level of the tape output over a range of ±40mV.
23	GAIN/CAL (Switch)	In the CAL position (to the left), the VARIABLE GAIN control (Item 5) is removed from the feedback circuit and the amplifier gain is as expressed by the GAIN switch setting.
24	TAPE OUTPUT (Terminals)	Recessed pin jacks provided for monitoring the output from the TAPE Amplifier.
25	BALANCE (Indicator)	A dual (Red/Green) LED is used as a visual indication for tape output zero. If the output is positive, the LED will be red; if negative, the LED will be green. The LED will be off if the output voltage falls within ±1.0mV of zero level.

3.4 BRIDGE CONFIGURATION

This section includes procedures for connecting the transducer to the appropriate connector pins and for mounting bridge-completion resistors required for the various resistance transducers.

Provision is made on the Bridge Completion Card Assembly for mounting up to eight bridge-completion resistors which may be connected in pairs for each arm of the bridge. Also, an 8-section DIP switch (S-3) may be installed on the board to enable rapid selection of any of the eight resistors mounted. Figure 3-2 is a schematic representation of all the bridge-completion resistors including the DIP switches. Figure 3-3 is an assembly drawing of the Bridge Completion Card highlighting locations for the various resistors and the switch.

****
* NOTE *
****

Before installing a DIP switch in the S3 position, all traces on component side between opposite pins must be severed or the switches will be shorted out.

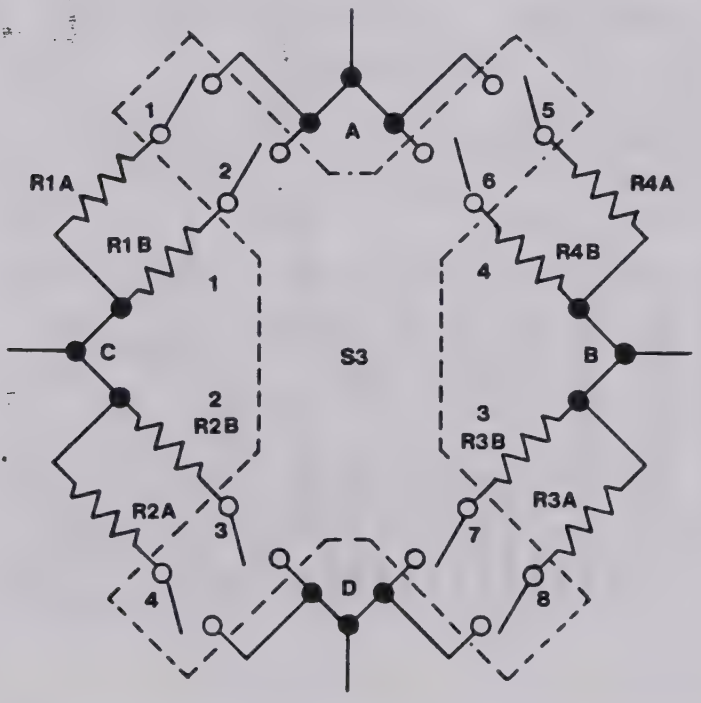


Figure 3-2 Bridge Completion Resistor Schematic

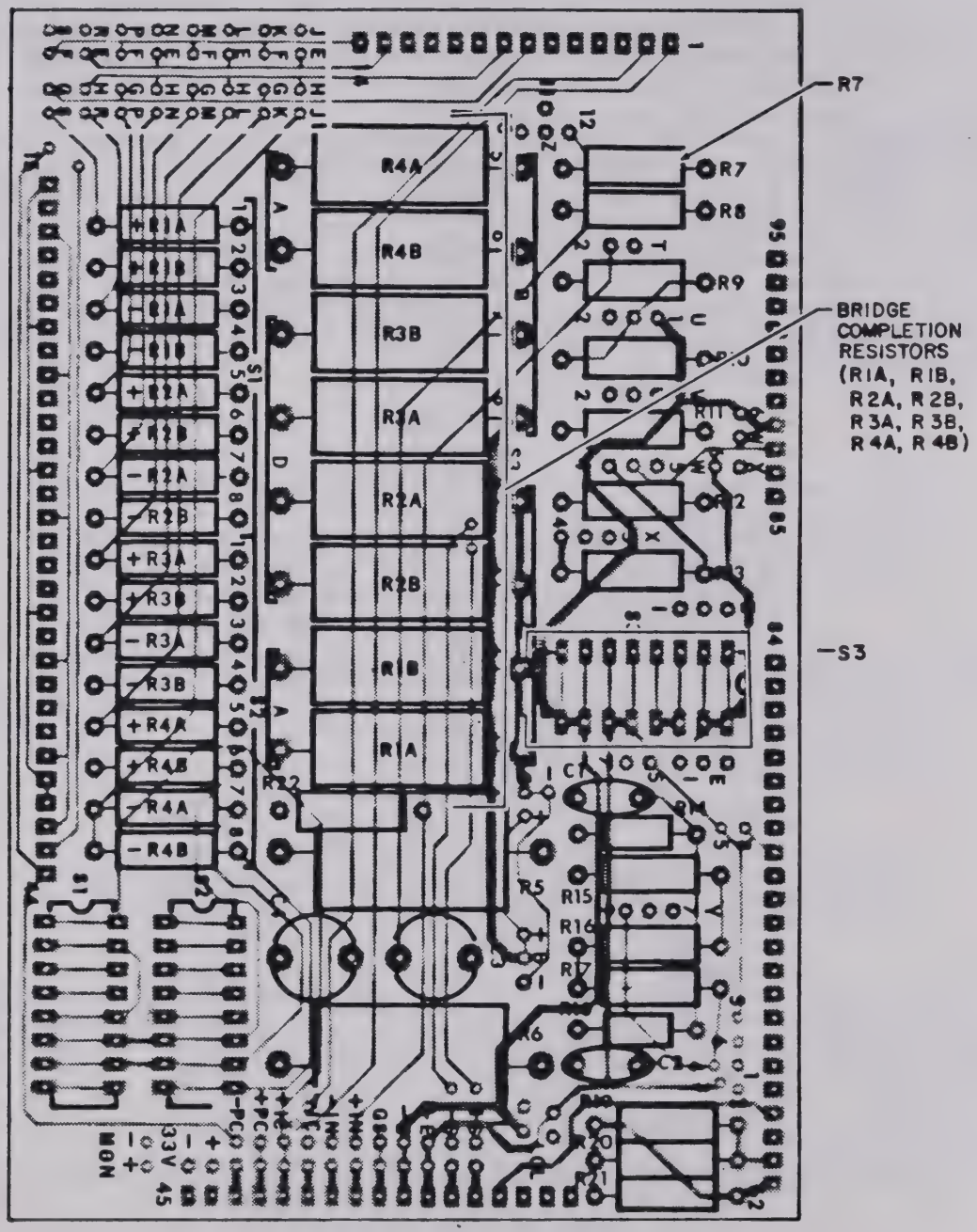


Figure 3-3 Bridge Completion Resistor and Switch Location

3.4.1 One-Active-Arm Bridge Configuration

There are several basic one-active-arm bridge configurations; local bridge completion, remote adjacent arm, and remote bridge completion. These configurations are described below.

3.4.1.1 One-Active-Arm Bridge with Local Bridge Completion

Illustrated in Figure 3-4, this circuit has all the bridge completion resistors mounted on the Bridge Completion Board which contains the simplest wiring configuration and installation. The circuit shows three wires plus shield coming from the gage. The third wire is for lead compensation and allows the gage to be mounted a long distance from the signal conditioner without creating zero errors due to lead resistance. With this circuit, gage power flows through the +INPUT lead, through the strain gage and back to -EXC. Because of the -INPUT lead to the 7600A Amplifier, the +INPUT lead resistance is in series with R1A and the -EXC lead resistance is in series with the strain gage. Therefore a direct cancellation of lead resistance is accomplished, assuming the same wire gage is used for all three leads.

3.4.1.2 One-Active-Arm Bridge with Remote Adjacent Arm

Figure 3-5. A single-active-arm strain gage circuit with a remote dummy adjacent arm. This configuration provides temperature compensation for the active gage when the dummy gage is the same type as the active gage. With this circuit the dummy gage need only be in the same temperature environment as the active gage. The 3-wire connection for the active gage must be maintained as described in 3.4.1.1.

3.4.1.3 One-Active-Arm Bridge with Remote Bridge Completion

Figure 3-6. A one-active-arm bridge configuration with remote bridge completion. This configuration provides the best lead compensation and is recommended when the input lines are long or required accuracies are tight. Figure 3-6 shows the wiring for a 10-wire system. This wiring configuration provides for ±2 set double shunt calibration and remote sensing of excitation. The wiring can be reduced to any configuration as low as four wires plus shield. Figure 3-7 illustrates a 4-wire plus shield configuration.

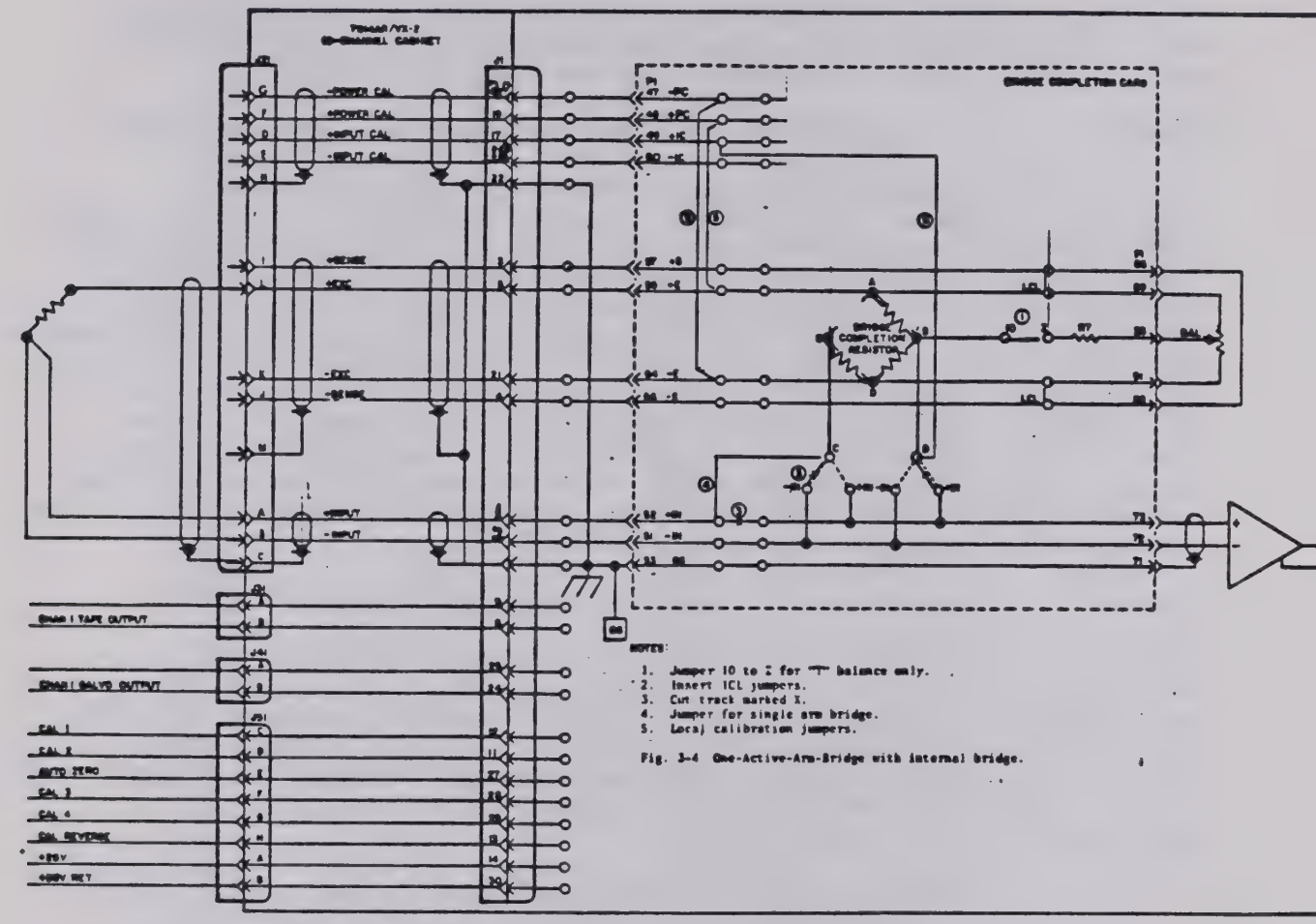
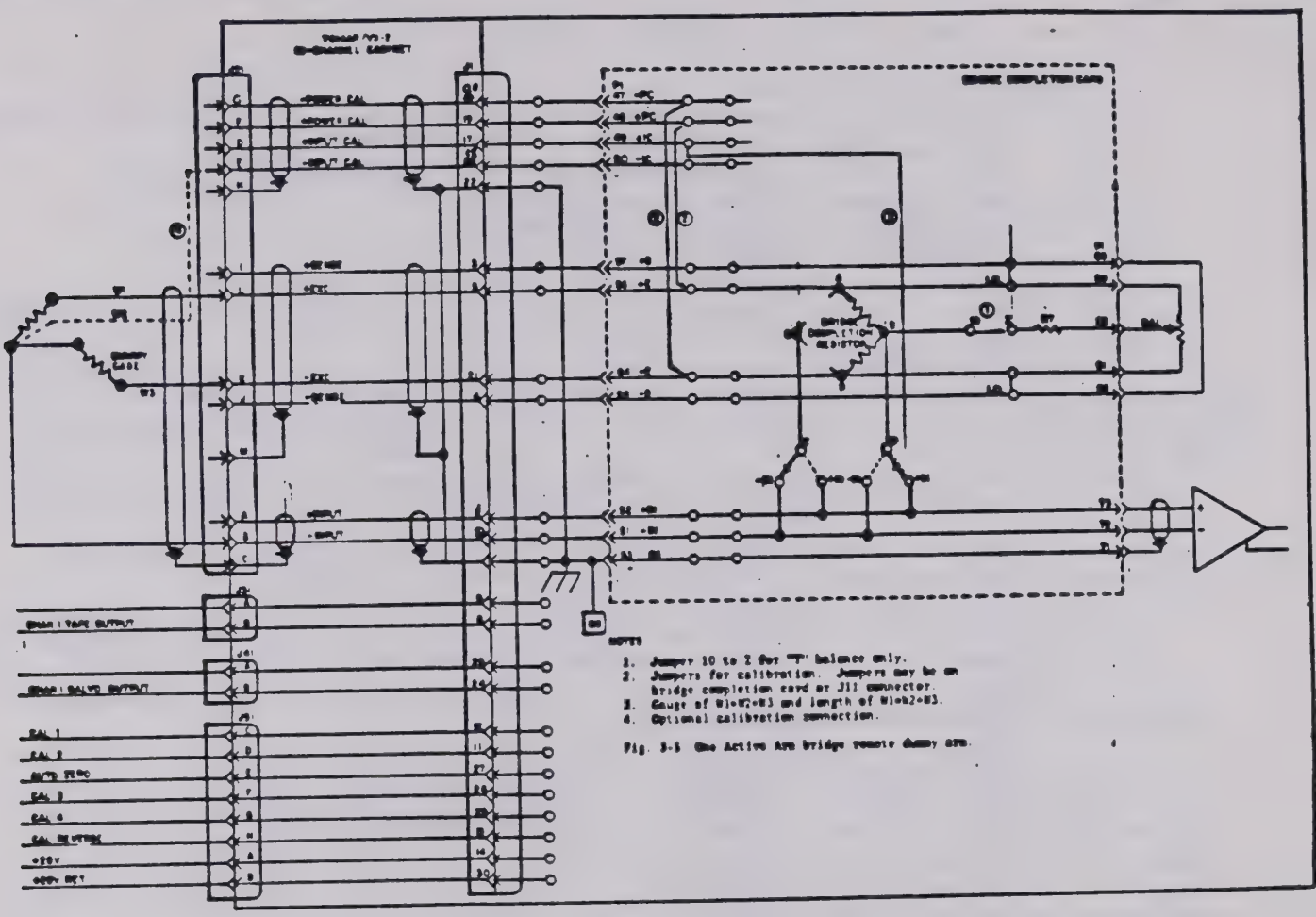


Fig. 3-4 One-Active-Arm-Bridge with Internal Bridge.

NOTES:

1. For 3-wire input cable, jumper +INPUT CAL to -INPUT.
2. Insert LCL jumpers.
3. Select either constant voltage or constant current excitation. (See Section 3.5)
4. For proper connector pin identification, see Table 2-1.
5. Resistors R1A, R2A, R4A, and R7, mount on the Bridge Completion Board. See Figure 3-3.

Figure 3-4 One-Active-Arm-Bridge with Internal Bridge Completion



NOTES:

1. The +INPUT CAL wire may be tied at the dummy gage or at the -INPUT point or the input connector.
2. Insert LCL jumpers.
3. Select either constant voltage or constant current excitation. (See Section 3.5)
4. For proper connector pin identification, see Table 3-1.
5. Resistors R24, R44, and R7, mount on the Bridge Completion Board. See Figure 3-3.

Figure 3-5 One-Active-Arm Strain Gage with Dummy Gage

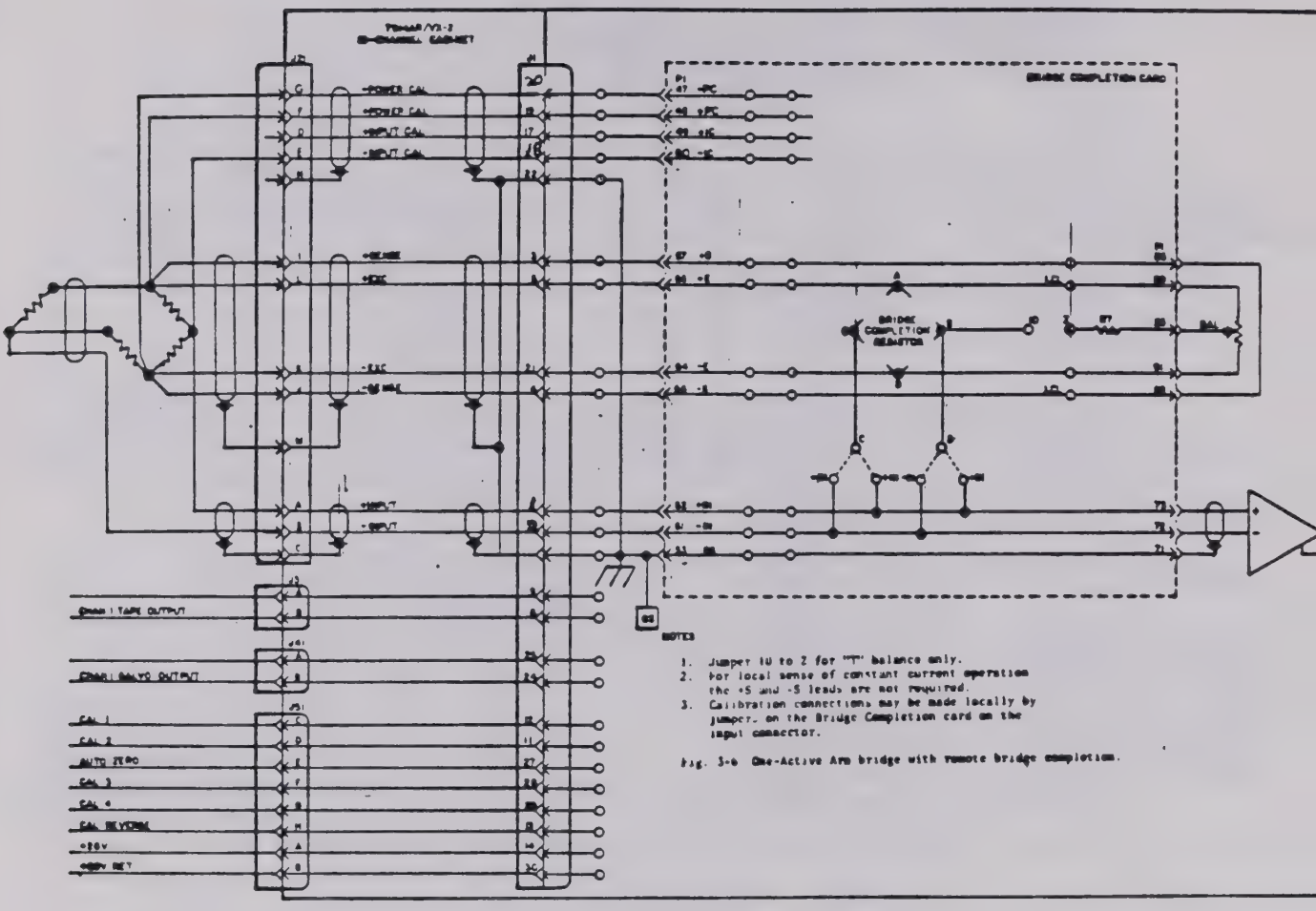

BRIDGE COMPLETION CARD
BRIDGE COMPLETION RESISTOR
NOTES
1. Jumper 10 to 2 for "T" balance only.
2. For local sense of constant current operation the +S and -S leads are not required.
3. Calibration connections may be made locally by jumpers on the Bridge Completion card on the input connector.

Fig. 3-6 One-Active Arm bridge with remote bridge completion.

NOTES:

1. Disconnect LCL jumpers for constant voltage excitation.
2. For proper connector pin identification, see Table 2-1.
3. Insert jumper from 2 to 10 as shown above.
4. For local sense or constant current operation, the +SENSE and -SENSE leads are not required.
5. Calibration connections may be made locally by jumpers on the input connector.

Figure 3-6 One-Active-Arm Strain Gage with Remote Bridge Completion

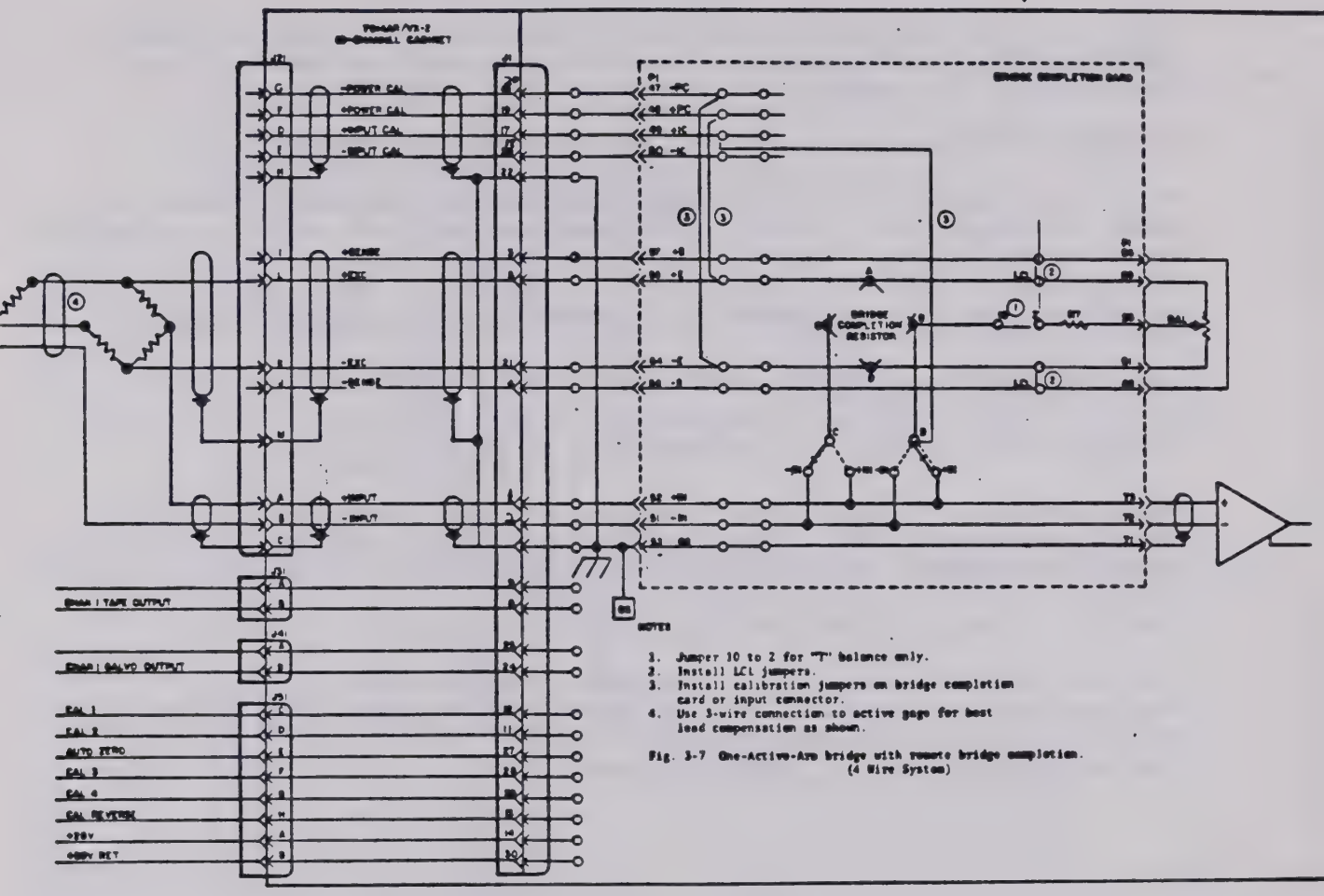

BRIDGE COMPLETION CARD
BRIDGE COMPLETION RESISTOR
NOTES
1. Jumper 10 to 2 for "T" balance only.
2. Install LCL jumpers.
3. Install calibration jumpers on bridge completion card or input connector.
4. Use 3-wire connection to active gage for best lead compensation as shown.

Fig. 3-7 One-Active-Arm bridge with remote bridge completion. (4 Wire System)

NOTES:

1. Insert LCL jumpers.
2. Select either constant voltage or constant current excitation. (See Section 3.5.)
3. For proper connector pin identification, see Table 2-1.
4. For single shunt calibration, the jumper between -POWER CAL and -EXC is not required.
5. Use 3-wire active gage connection as shown for best lead compensation.

Figure 3-7 One-Active-Arm Bridge with Remote Bridge Completion (4-wire System)

3.4.2 Two-Active-Arm Bridge Configuration

There are two available bridge configurations that may be used with 2-active-arm strain gages. The first circuit has local bridge completion. The second has remote bridge completion.

3.4.2.1 Two-Active-Arm Bridge with Local Completion

The 2-active-arm "adjacent" gage with local bridge completion is shown in Figure 3-8. This configuration requires the fewest connections to the bridge itself. For gain compensation with long input leads, remove the LCL jumpers. Then tie the +SENSE and -SENSE leads to the active gage as shown in Figure 3-8 by the dashed lines.

A 2-active-arm "opposed" gage with local bridge completion is illustrated in Figure 3-9.

3.4.2.2 Two-Active-Arm Bridge with Remote Completion

The advantage of this circuit is better lead compensation. This circuit also provides a wide variety of wiring configurations from four to 10 wires. Figure 3-10 illustrates the circuit for 10 wires.

3.4.3 Four-Active-Arm Bridge Configuration

Figures 3-6, 3-7 and 3-10 illustrate circuits that can be used for 4-active-arm applications by replacing the summing arms or remote completion arms with active arms. Figure 3-11 illustrates the 8-wire system which is commonly used.

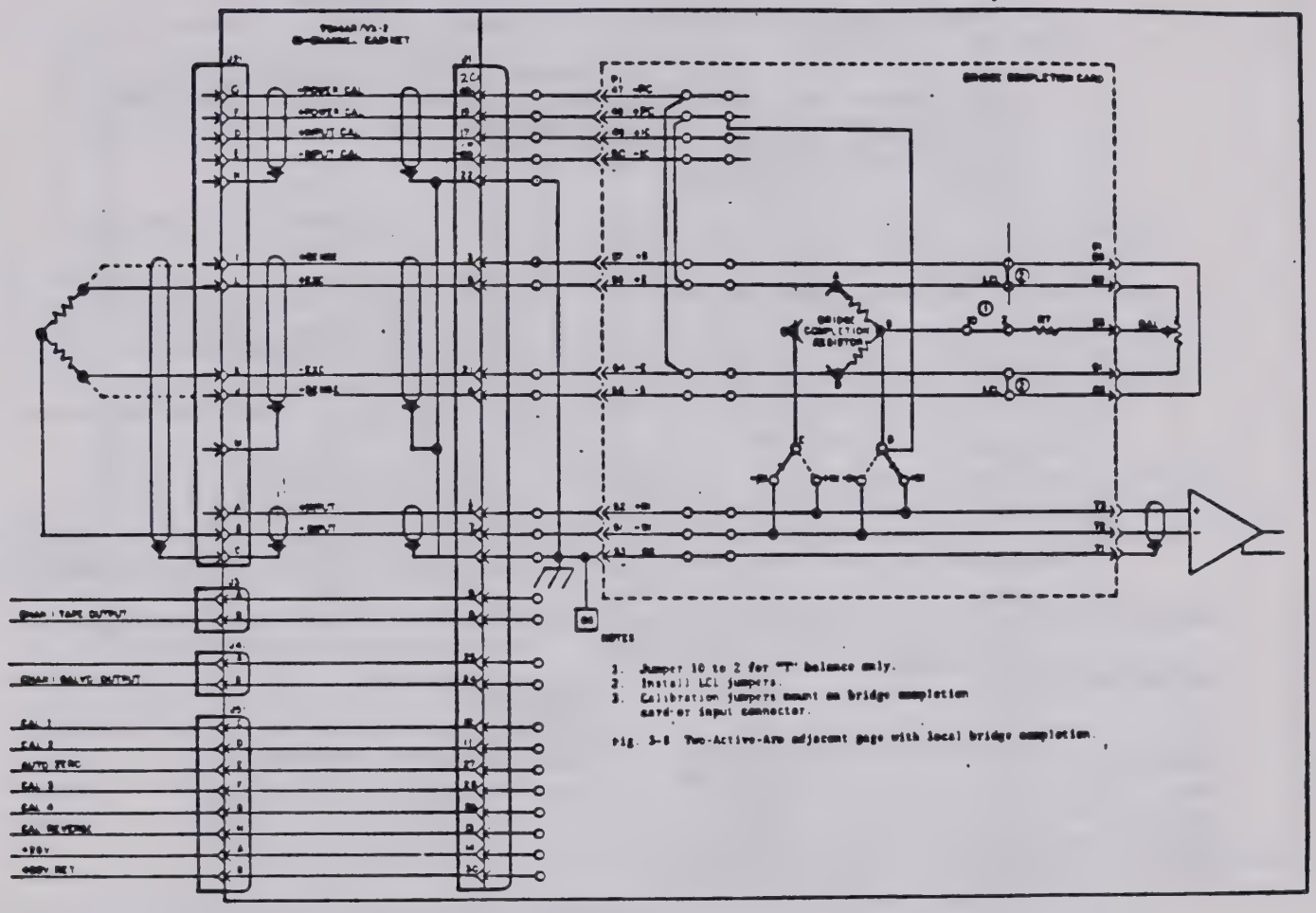

BRIDGE COMPLETION CARD
BRIDGE COMPLETION RESISTOR
NOTES
1. Jumper 10 to 2 for "T" balance only.
2. Install LCL jumpers.
3. Calibration jumpers mount on bridge completion card or input connector.

Fig. 3-8 Two-Active-Arm adjacent gage with local bridge completion.

NOTES:

1. The +INPUT CAL wire may be tied at the +SENSE point on the input connector.
2. Insert LCL jumpers.
3. Select either constant voltage or constant current excitation. (See Section 3.5.)
4. For proper pin connector identification, see Table 2-1.
5. Resistor R1A, R2A, and R7, mount on the Bridge Completion card. See Figure 3-3.

Figure 3-8 Two-Active-Arm Adjacent Gage with Local Completion

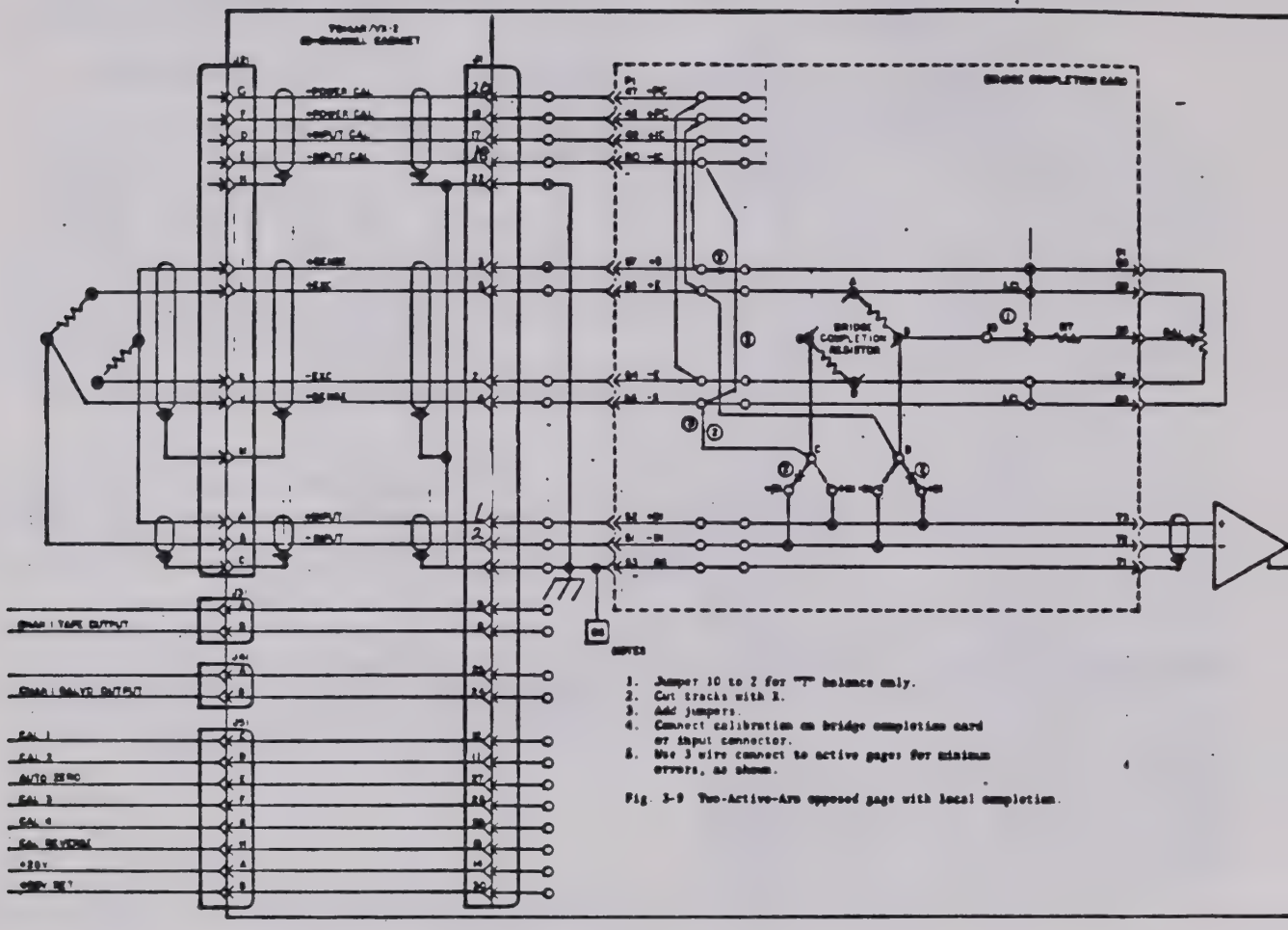

BRIDGE COMPLETION RESISTOR
NOTES
1. Jumper 10 to 2 for "T" balance only.
2. Cut tracks with X.
3. Add jumpers.
4. Connect calibration on bridge completion card or input connector.
5. Use 3 wire connect to active gage: for minimum errors, as shown.

Fig. 3-9 Two-Active-Arm opposed gage with local completion.

NOTES:

1. The +INPUT CAL wire may be tied to the +SENSE point on the input connector.
2. Insert LCL jumpers.
3. Select either constant voltage or constant current excitation. (See Section 3.5.)
4. For proper pin connector identification, see Table 2-1.
5. Resistor R2A, R4A, and R7, mount on the Bridge Completion card. See Figure 3-3.

Figure 3-9 Two-Active-Arm Opposed Gage with Local Completion

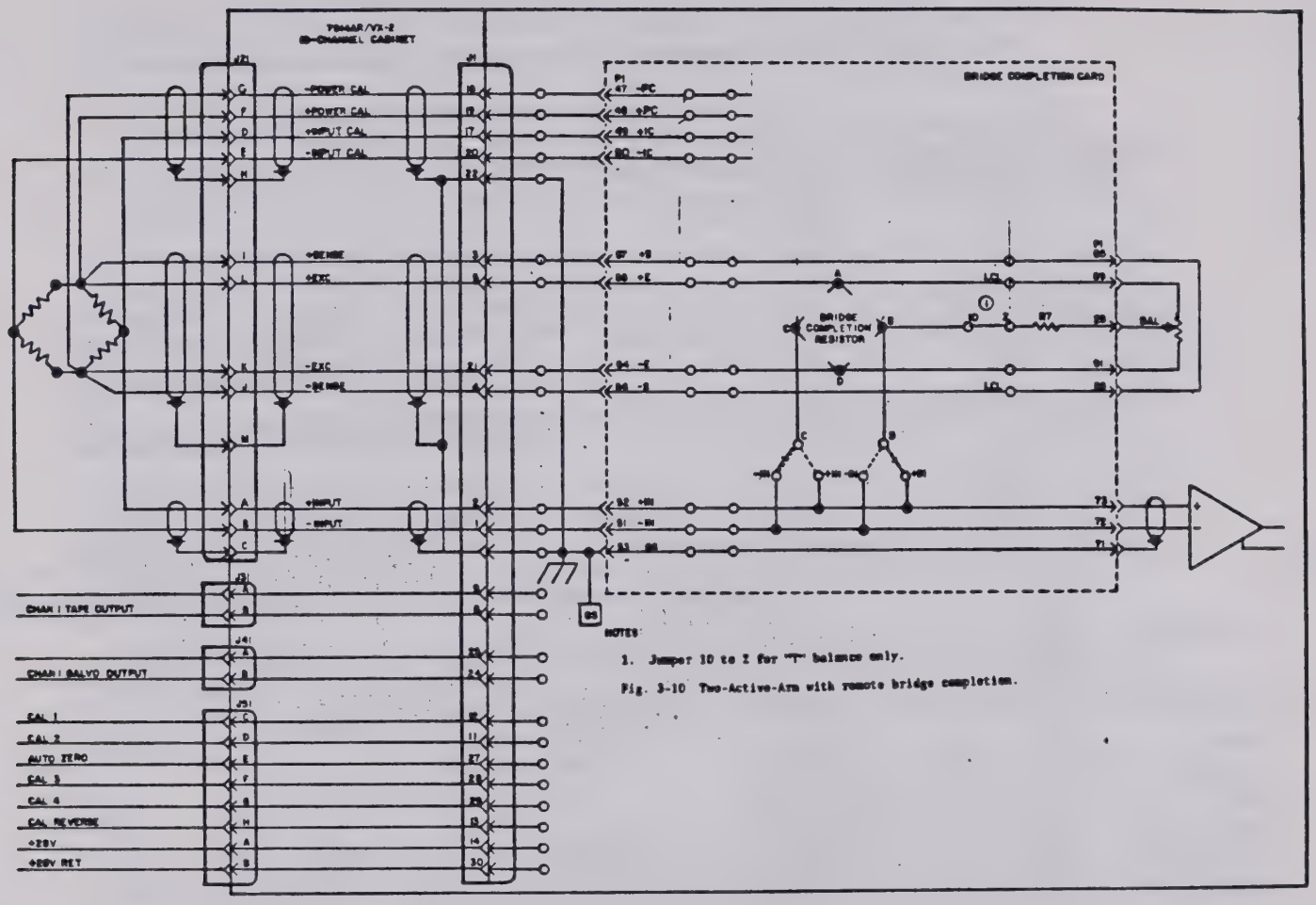
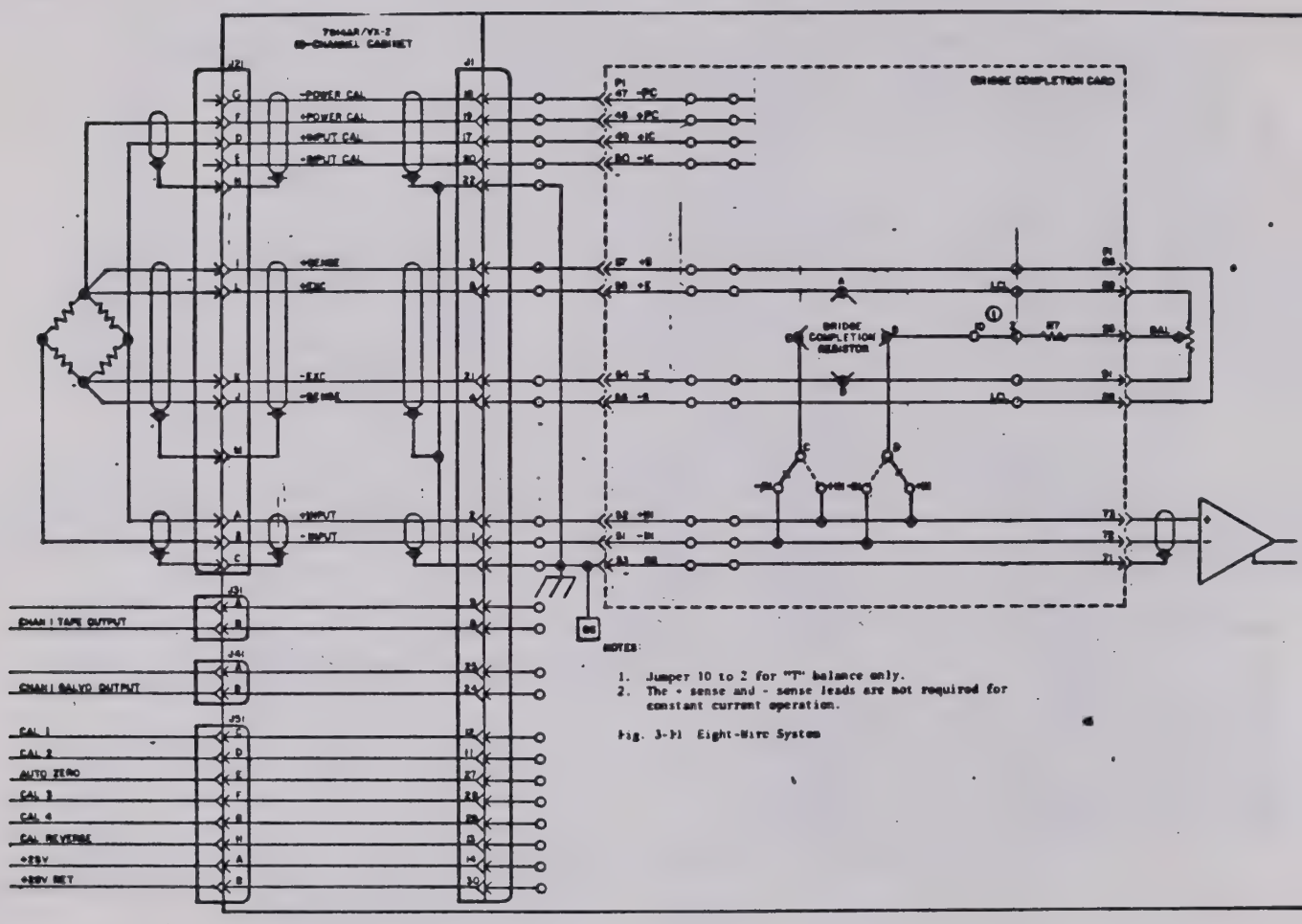


Fig. 3-10 Two-Active-Arm with remote bridge completion.

NOTES:

1. Remove LCL jumpers for constant voltage excitiation.
2. For proper connector pin identification, see Table 2-1.
3. Insert jumper from 2 to 10 as shown above.
4. The +SENSE and -SENSE leads are not required for constant current operation.
5. Calibration connections may be made locally by jumpers on the input connector.

Figure 3-10 Two-Active-Arm Bridge with Remote Bridge Completion



NOTES:

1. Jumper 10 to 2 for "T" balance only.
2. The + sense and - sense leads are not required for constant current operation.

Fig. 3-11 Eight-Wire System

NOTES:

1. Remove LCL jumpers for constant voltage excitation.
2. For proper connector pin identification, see Table 2-1.
3. Insert jumper from 7 to 10 as shown above.
4. The +SENSE and -SENSE leads are not required for constant current operation.

Figure 3-11 Eight-Wire System

3.5 CONSTANT VOLTAGE/CURRENT SELECTION

Constant Voltage or Constant Current operation may be selected as required. The selected mode is made effective by removing or inserting various jumpers on the Bridge Completion card.

3.5.1 Constant Voltage

Select Constant Voltage by inserting jumpers in both "E" pads as indicated in Figure 3-12.

For local sense: Insert jumpers in designated "LCL" pads, and remove the "+S" and "-S" jumpers.

For Remote Sense: The "LCL" jumpers must be removed and jumpers inserted in "+S" and "-S" pads.

3.5.2 Constant Current

Select Constant Current by inserting jumpers in both "I" pads as indicated in Figure 3-13. In addition, remove all jumpers from "LCL", "+S", and "-S" pads.

3.6 EXCITATION SELECTION

Either Preset or Limited Range Excitation may be selected as required. The desired mode is made effective by cutting traces and installing appropriate resistors on the Bridge Completion card.

3.6.1 Preset Excitation

When Preset Excitation is selected, it is necessary to cut the traces at two locations (one on the component side and one on the reverse side) and inserting a jumper at "Y9" as indicated in Figure 3-14. In addition, a voltage divider consisting of R16 and R17 must be added to the board. The total impedance of the voltage divider must be greater than 20 kohm.

Design equations for determining resistance values are given below. Accuracy of the output voltage (or current) is $\pm 7\%$ plus the inaccuracies of the voltage divider components installed by the user.

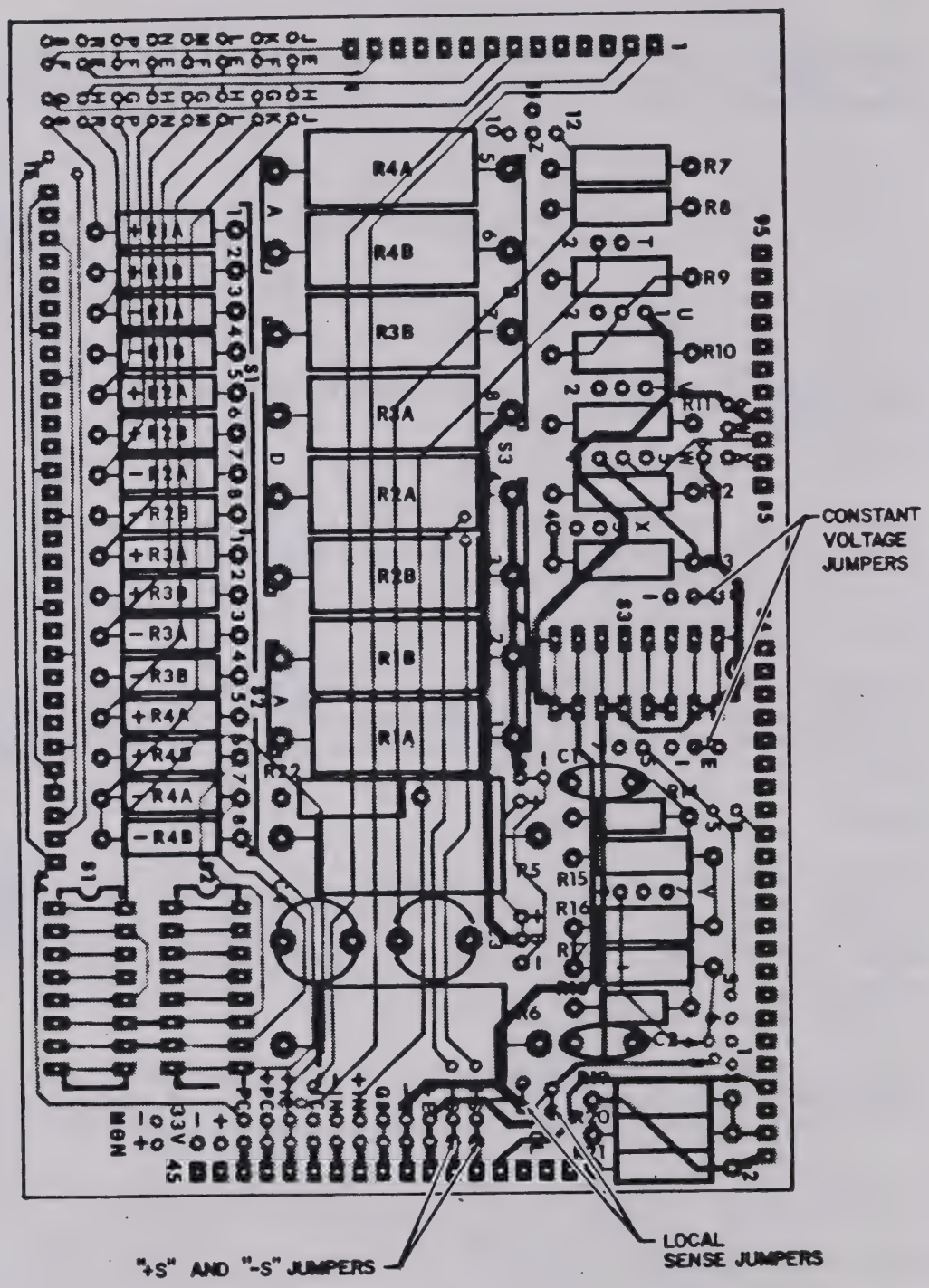


Figure 3-12 Constant Voltage Selection

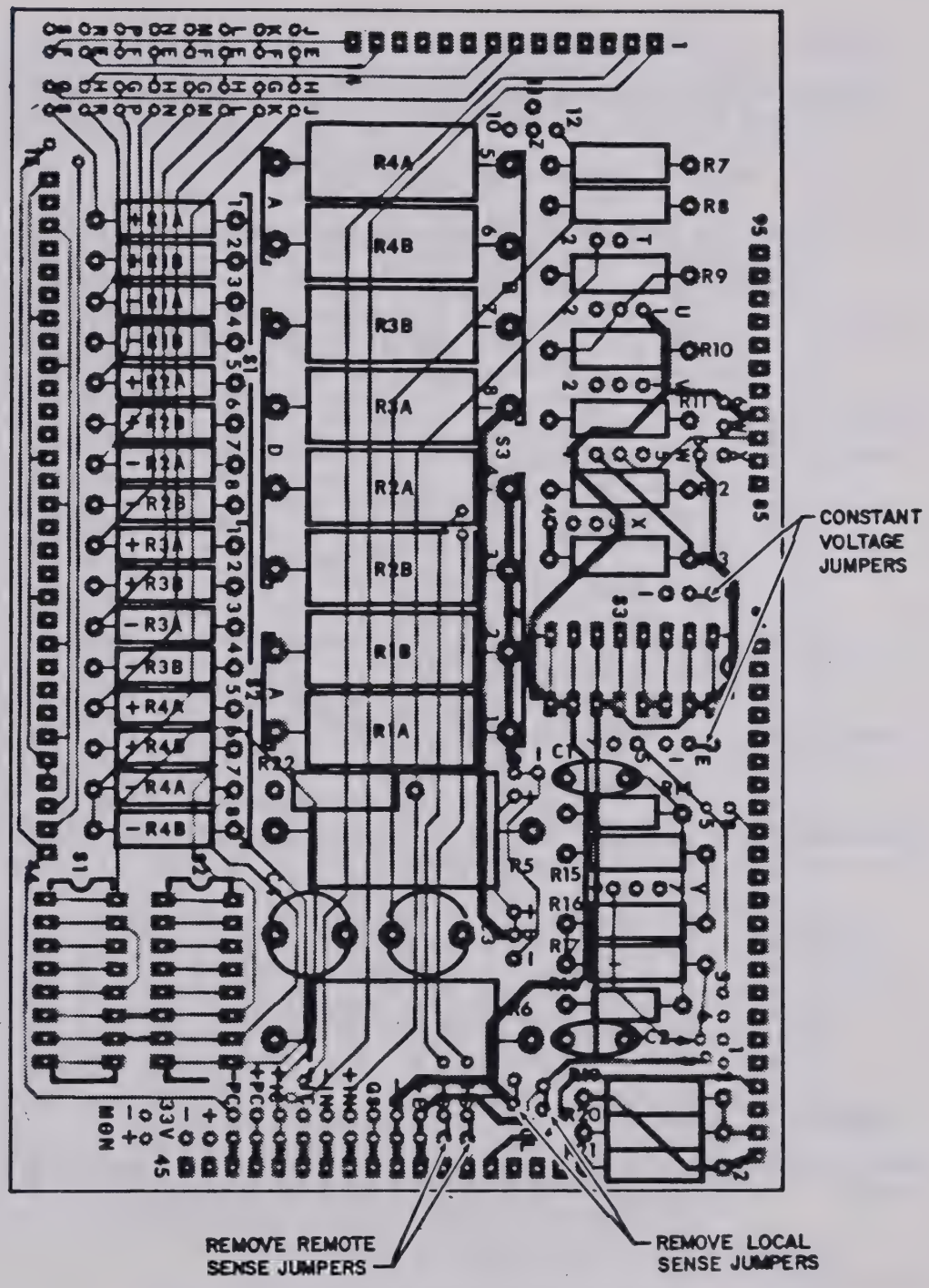


Figure 3-13 Constant Current Selection

3.6.1.1 15V Standard

For constant voltage operation using the standard 15V supply, values of R16 and R17 are found from:

$$Eout = (16 * R16)/(R16 + R17) \quad \text{(eq 1)}$$

where:
Eout is the desired output in volts.
R16 and R17 are the voltage divider resistors in ohms, and
(R16 + R17) > 20 kohm.

Example: It is desired to preset the excitation voltage to 10V using the standard 15V.

Condition 1 (R16 + R17) > 20000
Condition 2 10 = (16 * R16)/(R16 + R17)

Solution: Assume a value of 32000 for (R16 + R17) and substitute in equation 1. Then -

$$10 = (16 * R16)/(32000)$$

and solving for R16 -

$$(10 * 32000)/16 = R16$$

R16 = 20,000 ohm, and
R17 = 12,000 ohm.

3.6.1.2 30V Optional

For constant voltage operation using an Optional 30V, values of R16 and R17 are found from:

$$Eout = (32 * R16)(R16 + R17) \quad \text{(eq 2)}$$

where:
Eout is the desired output in volts,
R16 and R17 are the voltage divider resistors in ohms, and
(R16 + R17) > 20 kohm.

3.6.1.3 Constant Current

For constant current operation, values of R16 and R17 are found from:

$$Iout = (106 * R16)/(R16 + R17) \quad \text{(eq 3)}$$

where:
Iout is the desired current output in mA,
R16 and R17 are voltage divider resistors in ohms, and
(R16 + R17) > 20 kohm.

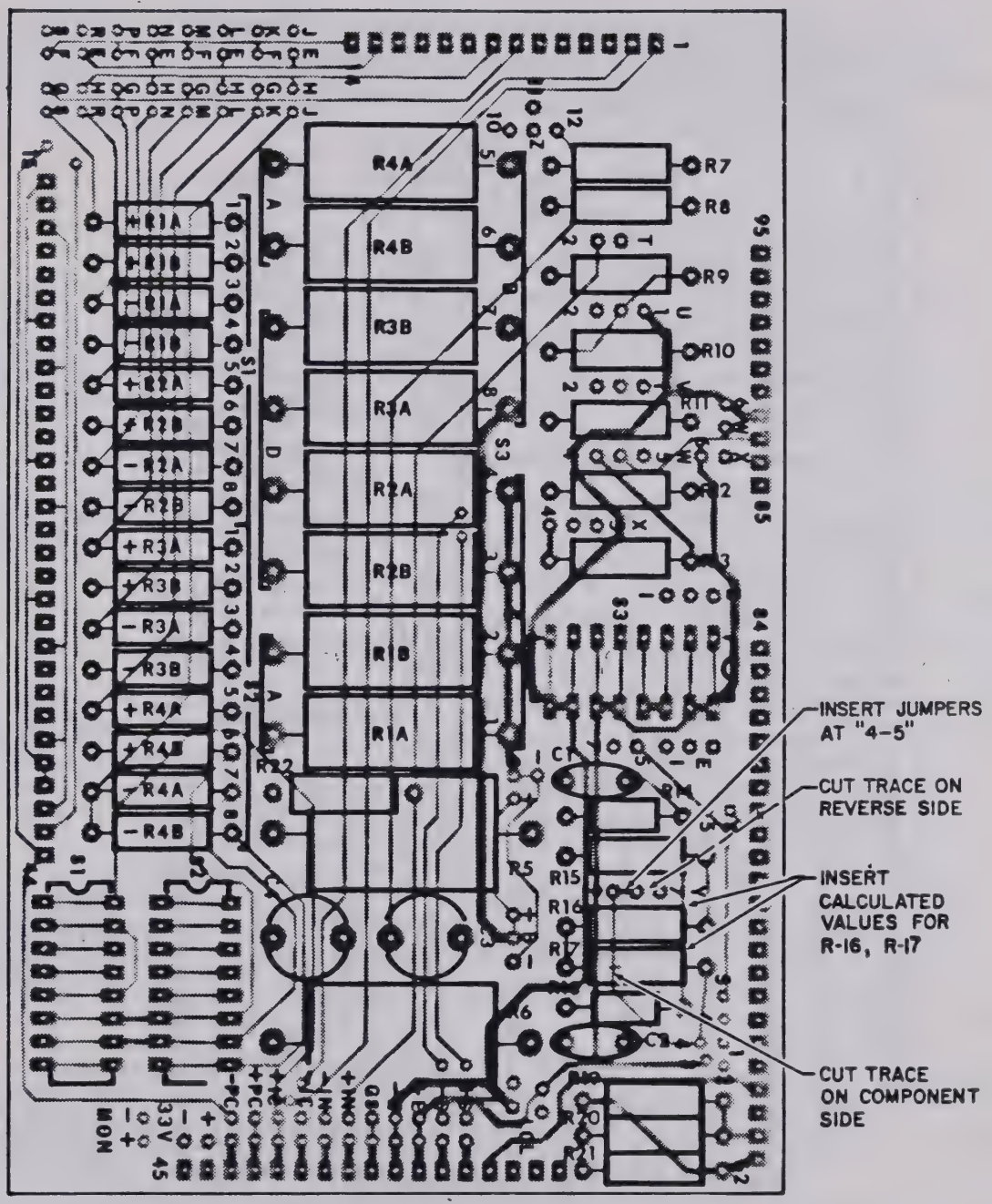


Figure 3-14 Preset Excitation

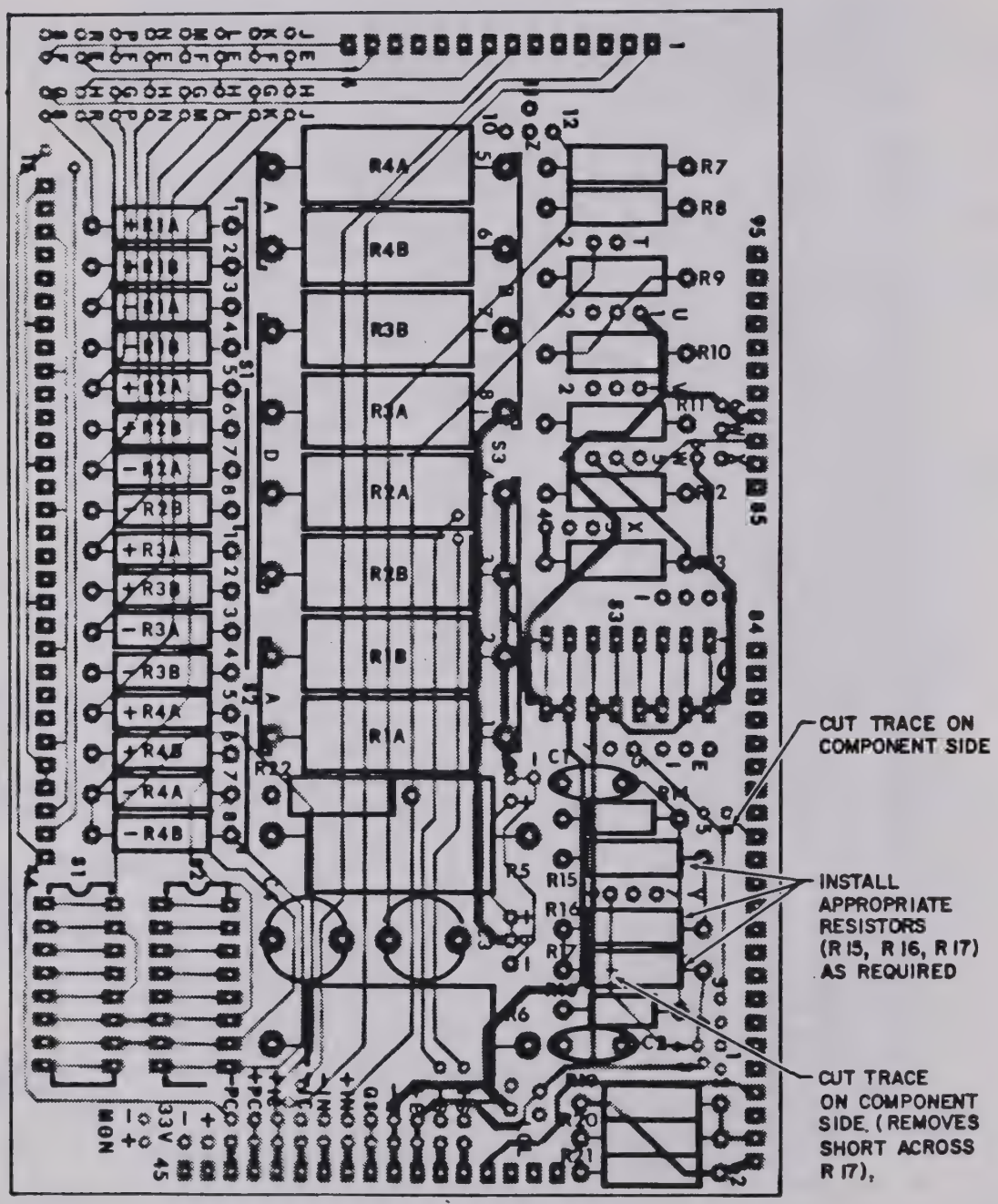


Figure 3-15 Limited Range Excitation

3.6.2 Limited Range Excitation

When Limited Range Excitation is selected, it is necessary to cut the traces at two locations on the component side as shown in Figure 3-15. In addition, resistances having appropriate values are inserted for R15, R16, and R17 as required.

```
********
* NOTE *
********
```

Cutting the two traces removes foil jumpers across R15 and R17.

Design equations for determining resistance values are given below. With these values, the voltage adjustment range will be within ±10% of the desired range.

3.6.2.1 15V Standard

For limited range excitation using the standard 15V supply, values of R15, R16, and R17 are found from:

$$R15 = E2/0.8 \quad \text{(eq 4)}$$

$$R16 = 20 * (E1 - E2)/(16 - E1 + E2) \quad \text{(eq 5)}$$

$$R17 = (16 - E1)/0.8 \quad \text{(eq 6)}$$

where:
E1 = Maximum desired output voltage
E2 = Minimum desired output voltage, and
R15, R16, R17 are all in kohm.

3.6.2.2 30V Optional

For limited range excitation using an optional 30V supply, values of R15, R16, and R17 are found from:

$$R15 = E2/1.6 \quad \text{(eq 7)}$$

$$R16 = 20 * (E1 - E2)/(32 - E1 + E2) \quad \text{(eq 8)}$$

$$R17 = (32 - E1)/1.6 \quad \text{(eq 9)}$$

where:
E1 = Maximum desired output voltage,
E2 = Minimum desired output voltage, and
R15, R16, R17 are all in kohm.

3.6.2.3 Constant Current

For Constant Current operation, values of R15, R16, and R17 are found from:

$$R15 = I2 * 0.1884 \quad \text{(eq 10)}$$

$$R16 = 20 * (I1 - I2)/(106 - I1 + I2) \quad \text{(eq 11)}$$

$$R17 = (106 - I1) * 0.1184 \quad \text{(eq 12)}$$

where:
I1 = maximum desired output current,
I2 = minimum desired output current, and
R15, R16, and R17, are all in kohm.

3.7 SHUNT CALIBRATION

Model 7600A calibration is performed by shunting bridge transducer arms with calculated values of calibration resistors to achieve a desired bridge offset. The user has the option of using either local or remote insertion of calibration resistors. Either single or double shunt calibration may be selected.

3.7.1 Local Mode

In Local Mode, only ±2 steps of shunt calibration is permitted. However, the user may utilize any of the ±4 steps of calibration available by selecting jumpers located on the bridge completion card.

Jumpers must be inserted (or jumper blocks placed if header was installed) to connect CAL1 switch (S5) to calibration step 1 and CAL2 switch (S6) to calibration step 2. With jumpers shown in Figure 3-16, RCAL1 resistors (±R1A and ±R1B) have been selected for step 1, and RCAL2 resistors (±R2A and ±R2B) have been selected for step 2. Jumper combinations for other possible RCAL resistor selection are listed in Table 3-2.

Table 3-2 Local Calibration Resistor Selection

To Select Calibration Resistor Step	For Cal 1 (S5) Connect Jumpers		For Cal 2 (S6) Connect Jumpers	
RCAL Step 1	G-S	H-R	F-S	E-R
RCAL Step 2	G-P	H-N	F-P	E-N
RCAL Step 3	G-M	H-L	F-M	E-L
RCAL Step 4	G-K	H-J	F-K	E-J

NOTE: Do not select same RCAL resistors for both CAL1 and CAL2 switches.

3.7.2 Remote Mode

Remote shunt calibration is selected by energizing the appropriate relays. Table 3-3 describes the required relay selection.

Table 3-3 Remote Relay Selection

Cal Step Selected	Energized	Control Lines Tied to +28V Return	P2
+1	K2	CAL 1	12
-1	K2,K6	CAL 1, Cal Reverse	12,13
+2	K3	CAL 2	11
-2	K3,K6	CAL 2, Cal Reverse	11,13
+3	K4	CAL 3	28
-3	K4,K6	CAL 3, Cal Reverse	28,13
+4	K5	CAL 4	29
-4	K5,K6	CAL 4, Cal Reverse	29,13

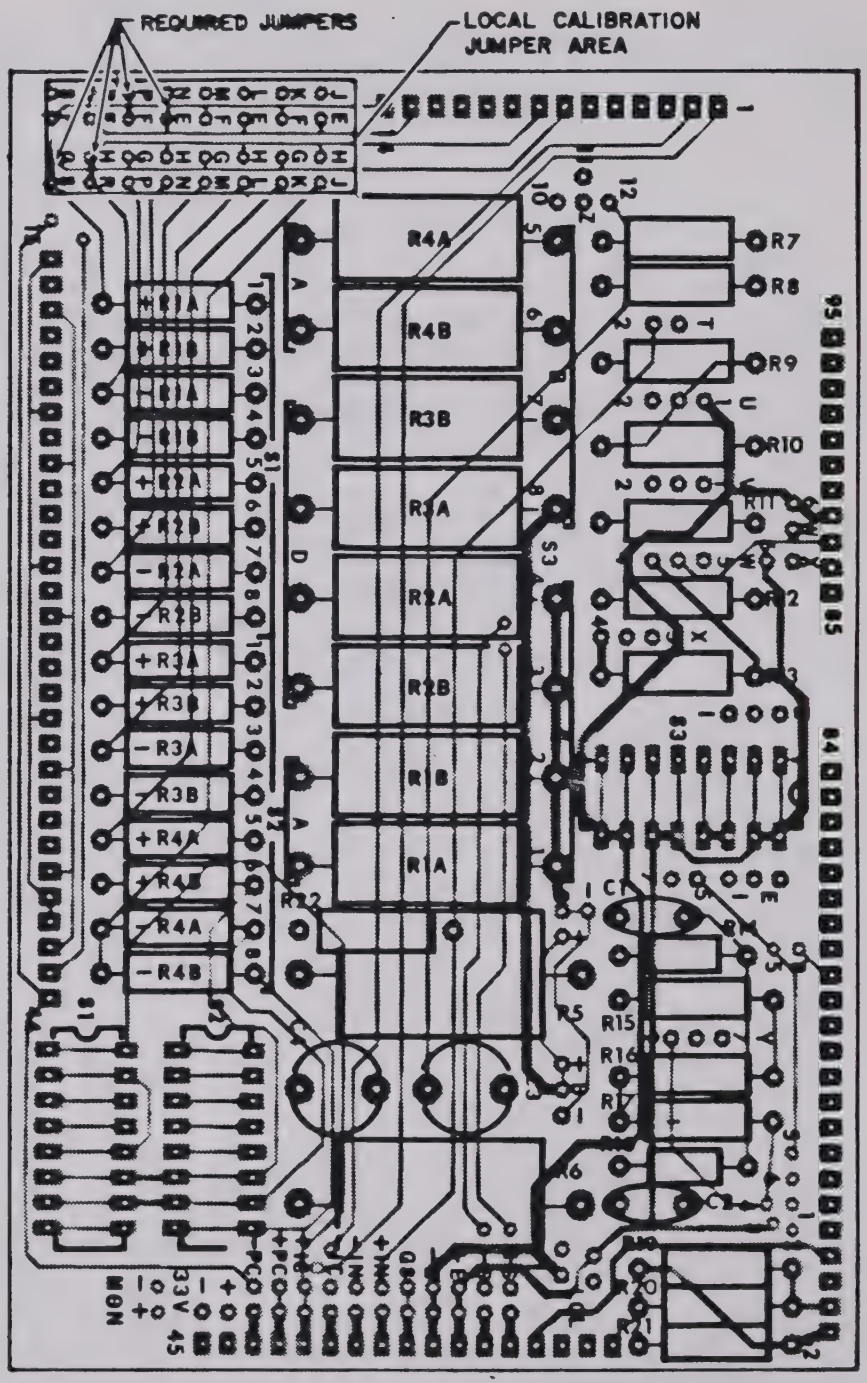


Figure 3-16 Local Calibration Connections

3.7.3 Double Shunt Calibration

Double-Shunt calibration incorporates two resistors usually of the same value. Each resistor shunts an opposite bridge arm as shown in Figure 3-17. Resistor selections and related calibration switch closures are listed in Table 3-4. See Figure 3-18 for mounting of calibration resistors and optional control switches.

Table 3-4 Remote Calibration Resistor Selection

CAL STEP	+SHUNT		-SHUNT		OPTIONAL +SHUNT		OPTIONAL -SHUNT	
	REF.	SW	REF.	SW	REF.	SW	REF.	SW
1	+R1A	S1-1	-R1A	S1-3	+R1B	S1-2	-R1B	S1-4
2	+R2A	S1-5	-R2A	S1-7	+R2B	S1-6	-R2B	S1-8
3	+R3A	S2-1	-R3A	S2-3	+R3B	S2-2	-R3B	S2-4
4	+R4A	S2-5	-R4A	S2-7	+R4B	S2-6	-R4B	S2-8

3.7.3.1 Double Shunt Calibration Resistor Calculation

The following equation should be used for calculation of each calibration resistor.

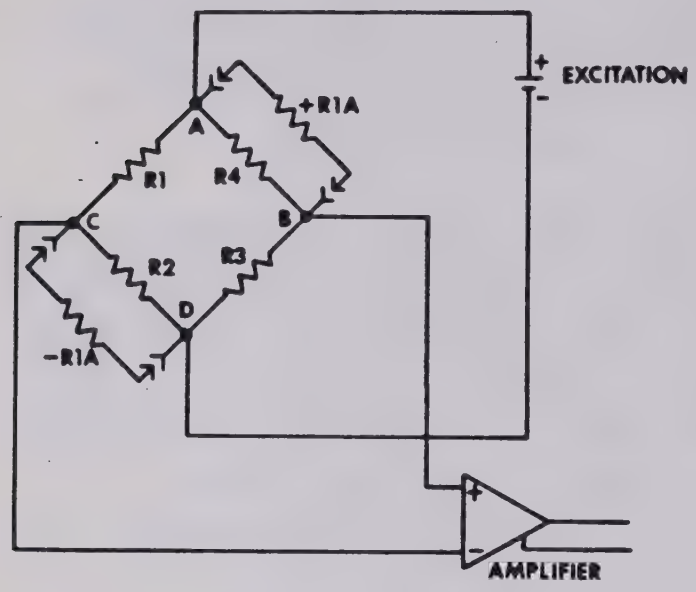
NOTE

For double-shunt calibration, each resistor contributes 1/2 the required calibration voltage. This is taken into account in the equation.

$$Rx = Rb * (1000-E)/(2*E) \qquad \text{(eq 13)}$$

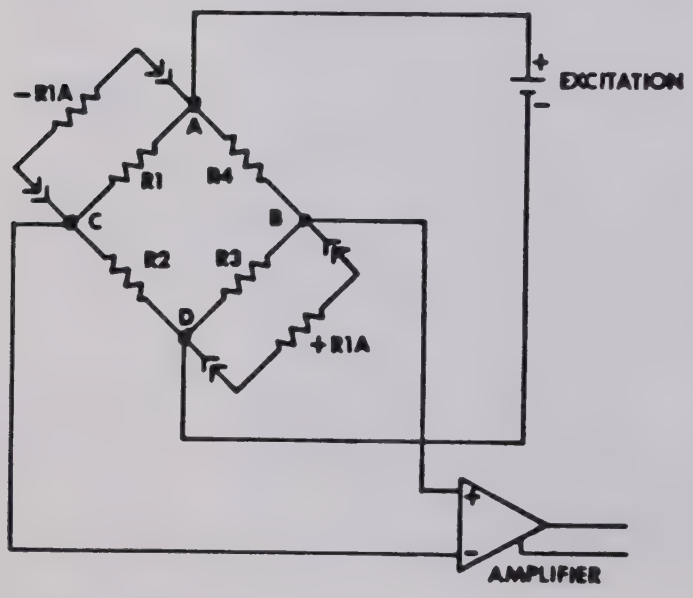
Where:

Rx is the desired shunt calibration resistor in ohms.
Rb is the bridge resistance in ohms.
E is the desired calibration voltage in mV/V.



CONDITIONS
1. CAL1 Switch set for (+).
2. S1 Switches 1 and 3 closed.
3. Place jumpers at H-R, G-S
4. -R1A and +R1A are used for calibration resistors.

(A) + STEP CALIBRATION



CONDITIONS
1. CAL1 Switch set for (-).
2. S1 Switches 1 and 3 closed.
3. Place jumpers at H-R, G-S
4. -R1A and +R1A are used for calibration resistors.

(B) - STEP CALIBRATION

Figure 3-17 Double-Shunt Calibration

Example:

Assume a 350 ohm bridge.
Desired calibration voltage is 10 mV/V.

Solution:

Rx = 350 * (1000-10)/(2*10)
= 350 * (990)/20
= 350 * 49.5
= 17,325 ohms

Therefore, each calibration resistor would be 17,325 ohms.

3.7.3 Single Shunt Calibration

Single shunt calibration is performed in a similar manner to that for double shunt calibration; however, for this method resistors -R1A, -R1B, -R2A, -R2B, -R3A, -R3B, -R4A, and -R4B are not used. The following equation should be used for calculation of the calibration resistance value:

$$Rx = (Rb * (500-E))/(2*E) \qquad \text{(eq 14)}$$

Where:

Rx is the desired shunt calibration resistor in ohms.
Rb is the bridge resistor in ohms.
E is the desired calibration voltage in mV/V.

3.7.3.1 Using Single Step Calibration With 16 Shunt Calibration Resistors

By simple modification, any of the 16 designated calibration resistors (±R1A, ±R1B, . . . ,±R4B) may be selected for single shunt calibration. The modification entails insertion of two jumpers and the insertion of DIP switches S1 and S2. (Refer to Section II for DIP switch installation procedures).

One jumper must be hand soldered to short P1-15 to P1-17. The other jumper connects the + INPUT CAL line to the - INPUT CAL line, which may be done with a jumper block if the wire-wrap headers have been previously installed. Jumper installation points and DIP switch locations with respect to related calibration resistors are shown in Figure 3-18.

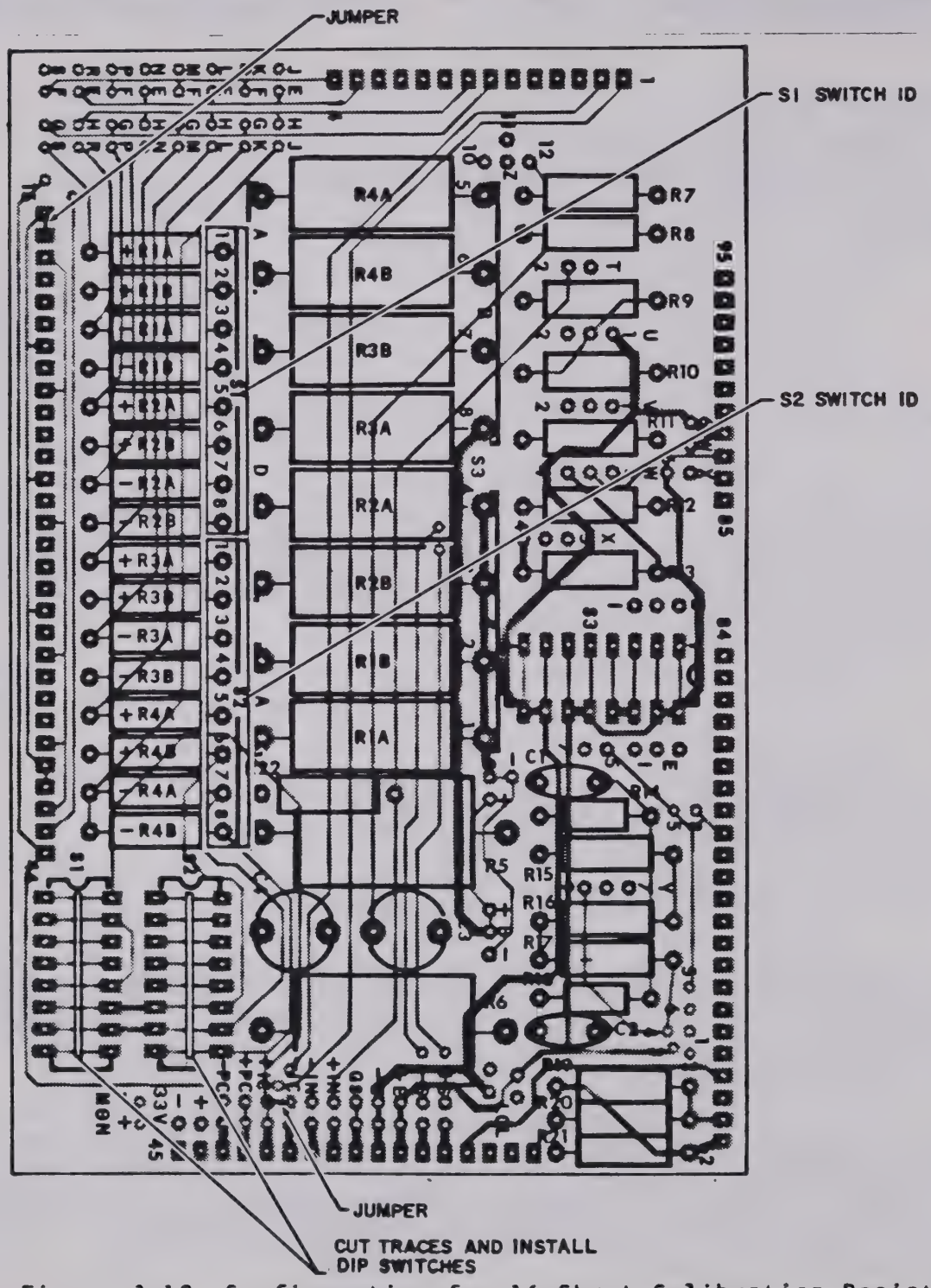


Figure 3-18 Configuration for 16 Shunt Calibration Resistors

Once the modification is made, + INPUT CAL, + POWER CAL, and - POWER CAL leads must be connected by the user to support plus and minus calibration.

Calibration resistor selection is made by closure of the appropriate DIP switch when enabled by its respective calibration step as listed in Table 3-4B.

Table 3-4B 1-of-16 Resistor Selection

CAL STEP*	SHUNT RESISTOR		SHUNT 1 OPTION		OPTIONAL SHUNT 2 OPTION		SHUNT 3 OPTION	
	REF.	SW	REF.	SW	REF.	SW	REF.	SW
1	+R1A	S1-1	+R1B	S1-2	-R1A	S1-3	-R1B	S1-4
2	+R2A	S1-5	+R2B	S1-6	-R2A	S1-7	-R2B	S1-8
3	+R3A	S2-1	+R3B	S2-2	-R3A	S2-3	-R3B	S2-4
4	+R4A	S2-5	+R4B	S2-6	-R4A	S2-7	-R4B	S2-8

*These numbers agree with remote CAL STEP designations.

3.8 Bridge Balance

There are three basic options that may be selected for the Bridge Balance feature. They are "T" Balance, Manual Voltage Insertion Balance, and Auto Balance (with and without battery). Operation with the various options is described in the following subsections.

3.8.1 "T" Bridge Balance

"T" Balance is furnished when Option 1 of Feature 6 has been selected by the user. For this option, the Bridge Completion Card is preset at the factory with a bridge balance limiting resistor, R7, having a value of 100 kohm. This resistor provides a balance of ±0.87 mV/V for a 350 ohm bridge, and ±0.3 mV/V for a 120 ohm bridge. Values for R7 can be computed for other bridge resistances and/or voltage ranges using the following equation:

$$R1 = (Rb * (500-E))/(2*E) \qquad \text{(eq 15)}$$

Where:
R1 is the limit resistor (R7) in ohms.
Rb is the bridge resistance in ohms.
E is the desired range in peak mV/V.

"T" balance is configured by inserting jumpers at V-1, U-1, and Z-10; and jumpers across resistors R10 and R11. See Figure 3-19.

Balance is achieved by adjustment of the front panel BALANCE control. Coarse balance is provided by fixed resistors R9 and R12.

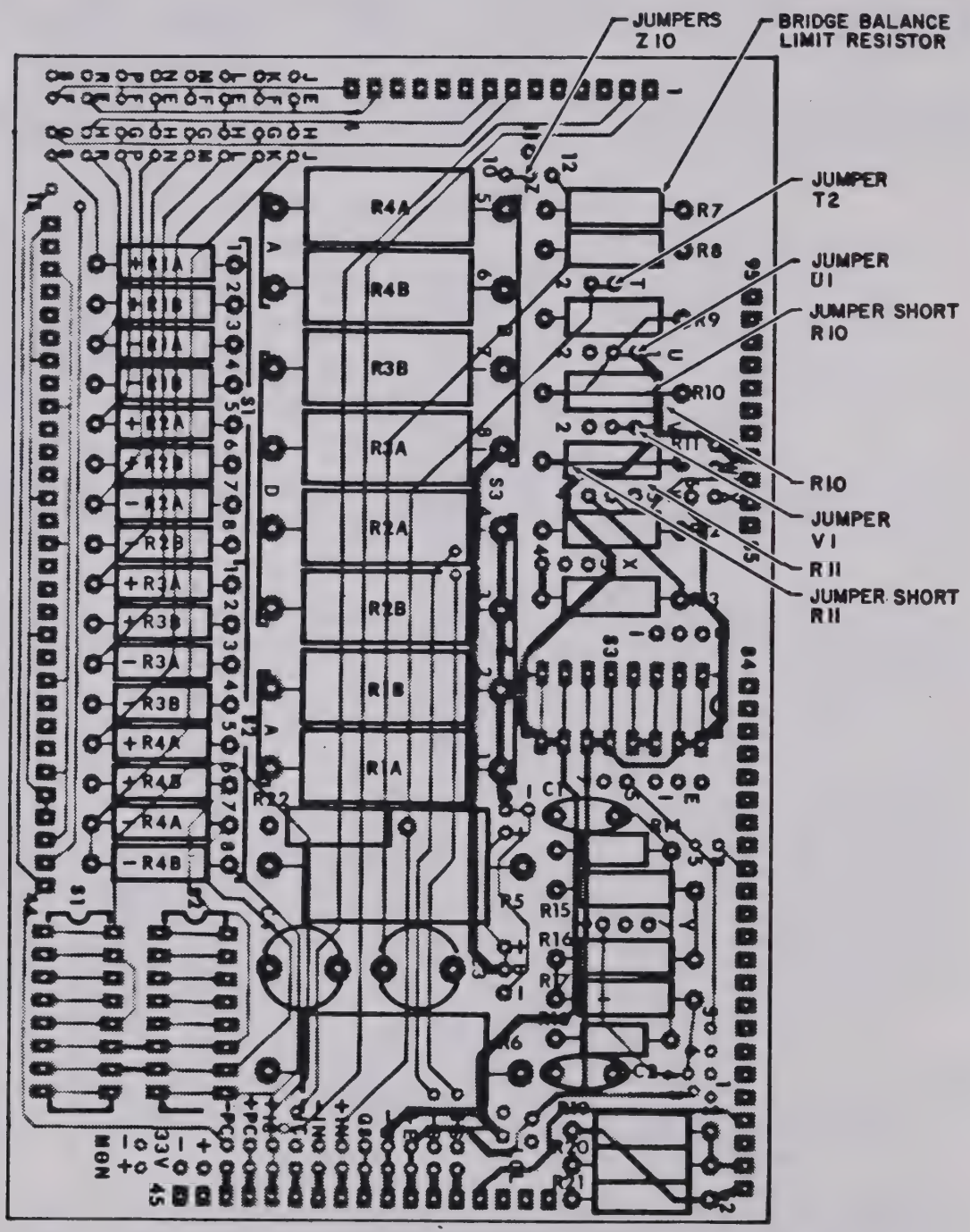


Figure 3-19 "T" Balance Configuration

3.8.2 Optional "T" Bridge Balance Circuit

An optional "T" Bridge Balance circuit is shown in Figure 3-20. In this circuit, resistors R10 and R11 function as the limiting resistors (R7 must be shorted out). This circuit provides the advantage of having significant range while maintaining good resolution around zero.

Resistance values for R10 and R11 are calculated from equation 16.

$$E = (((1/Rb)+(1/k10))/((1/20000+R10))+(1/R10)+(2/Rb))-0.5)*1000 \quad \text{(eq 16)}$$

Where:

- E = Range in peak mV/V
- Rb = Bridge resistance in ohms
- R10=R11 = Limit resistors in ohms

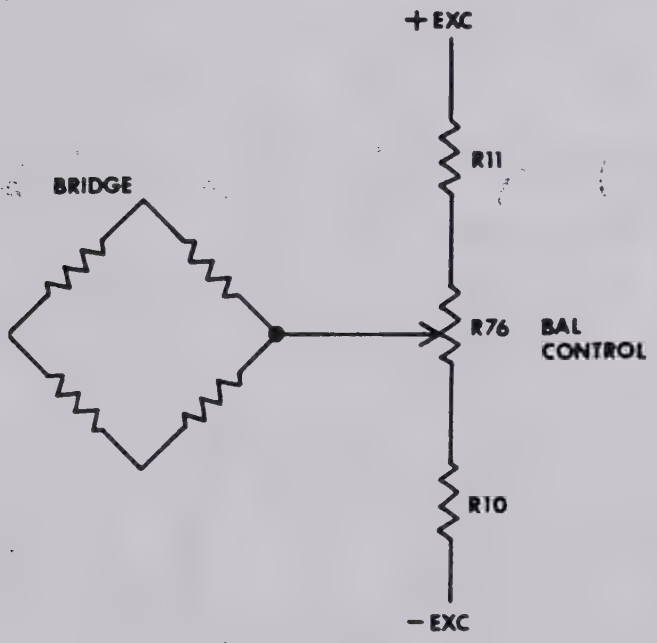


Figure 3-20 Optional "T" Bridge Balance Circuit

3.8.3 Voltage Insertion and Auto Balance

This function is incorporated whenever options 2, 3, or 4 of Feature 7 have been selected. For voltage insertion balance operation, the Auto Balance Sense leads (±ABS) must be connected to the bridge excitation voltage. When shipped from the factory these connections are made on the Bridge Completion card; with +ABS connected to +EXC (jumper from 1-3), and -ABS connected to -EXC (jumper from 5-7). These jumpers may be replaced by other jumpers according to the mode of operation selected by the user. The various modes are described in the following subsections. Jumper connection areas are indicated in Figure 3-21.

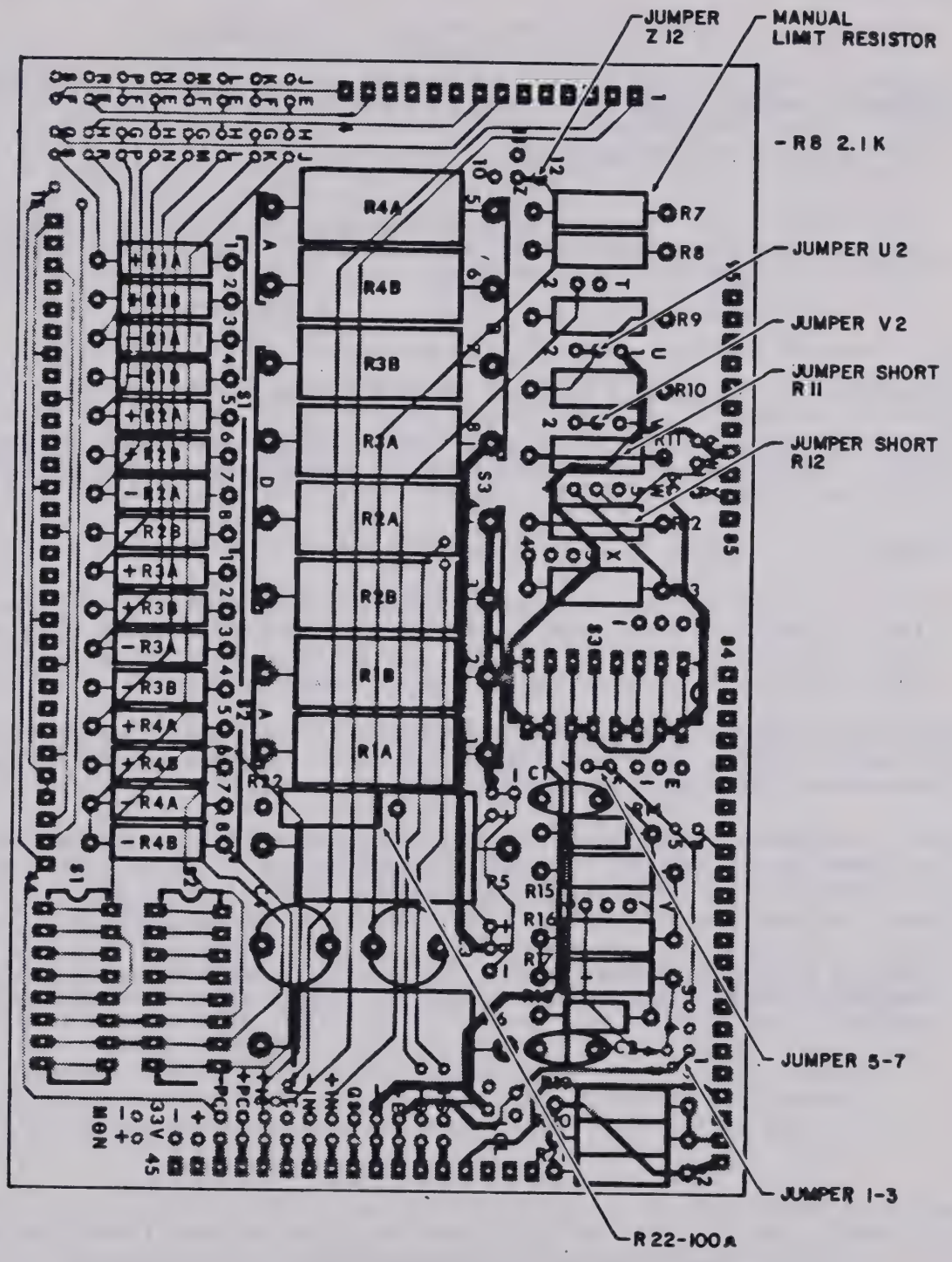


Figure 3-21 Voltage Insertion Balance Connections

3.8.3.1 Constant Voltage Bridge Connections

Either local or remote voltage sense may be used for this mode with jumpers connected as indicated in Table 3-5.

Table 3-5 Voltage Bridge Sense Jumpers

	EXCITATION VOLTAGE SENSE CONNECTIONS		CONSTANT
AUTO BALANCE LEADS	LOCAL	REMOTE	VOLTAGE
+ABS	1-3	1-3	1-4
-ABS	5-7	5-6	5-8

3.8.3.2 Constant Current Bridge Connections

For this mode of operation the +ABS lead is connected by inserting a jumper from 1-3 and the -ABS lead is connected by inserting a jumper from 5-7.

3.8.3.3 Other Connections

When the Auto Balance Sense (ABS) leads are connected to the excitation voltage, the voltage insertion circuit becomes a true ratiometric circuit; where the insertion voltage applied to the amplifier is proportional to the excitation voltage.

For example, if the insertion voltage is 5 mV with an excitation voltage of 10V, then when the excitation is reduced to 5V the insertion voltage will be reduced to 2.5 mV.

In some cases it may be undesirable to have the insertion voltage ratiometric to the excitation voltage; such as when a zero balance is provided for a thermocouple or some other emf signal source. If this is the case, then the +ABS lead must be jumpered between 1 and 4, and the -ABS lead must be jumpered between 5 and 8. These jumpers supply a constant 6.9V to the auto zero sense points, thus providing a constant output which is independent of the excitation supply.

3.8.3.4 Manual Voltage Insertion Range

The front panel BAL control range is controlled by the resistance values used for R7 and R22 on the Bridge Completion Card. These resistance values are preset at the factory to provide a range of 0.9 mV/V. This range may be changed by replacing R7 with a resistor whose value is determined from:

$$R7 = (100{,}000 - (300*E))/(3*E) \qquad \text{(eq 17)}$$

Where:
R7 is in ohms, and
E is the desired range in peak mV/V

The resistance of R7 must be greater than 3 kohm which limits the range to 10.7 mV/V. If a greater range is desired and R7 is calculated to be less than 3 kohm, then the value of R22 (100 ohm) must be raised so that R7 + R22 is greater than 3 kohm. When the value of R22 is increased, a new value for R7 may be calculated from:

$$R7 = ((1000*R22) - (3*R22*E))/(3*E) \qquad \text{(eq 18)}$$

Where:
R7 and R22 are in ohms, and
E is the desired range in peak mV/V

3.8.3.5 Auto Bridge Balance Range

The Auto Bridge Balance Control range is controlled by the values selected for R8 and R22 on the Bridge Completion Card. These values are preset at the factory to provide a zero range of 15 mV/V peak.

Resolution of the Auto Zero circuit is 1 part in 500,000, or 0.03 uV/V. The circuit is designed to zero within 500 uV at the TAPE output. The auto circuit contributes an error to the input of the amplifier due to unstability of the analog components involved.

Stability at the auto zero circuit output is typically 35 uV/degree C and 70 uV/8 hours. These values are divided in the voltage divider created by R8 and R22, so that the overall auto balance circuit creates an additional error of 1.6 uV/degree C and 3.2 uV/8 hours. Thus, increasing the divider ratio decreases the error; and at the same time it proportionally decreases the range. Conversely, decreasing the divider ratio results in the reverse output.

The divider values should be set to agree with the overall system accuracy requirements while maintaining maximum range. Equations 16 and 17 may be used to calculate different values for R8 and R22 for other desired ranges.

3.9 MONITOR CONFIGURATION

MONITOR pin jacks may be used to monitor various voltages and currents by setting the front panel MONITOR switch and inserting jumpers in the Bridge Completion Card. With the switch set to its EXC position, the excitation, sense voltages, or the current supplied to the transducer can be measured. Configuration of the Bridge Completion Card to enable these various measurements is described in the following subsections.

3.9.1 Excitation Monitor

Excitation voltage between the +EXC and -EXC lines can be measured by setting the MONITOR switch to EXC and inserting jumpers from X to 6 and W to 6 as shown in Figure 3-22.

3.9.2 Sense Monitor

Sense voltage between the +SENSE and -SENSE lines can be measured by setting the MONITOR switch to EXC and inserting jumpers from X to 5 and W to 5 as shown in Figure 3-23.

3.9.3 Current Monitor

Current supplied to the transducer is measured across R13 by setting the MONITOR switch to EXC and inserting jumpers from X to 4 and W to 4, and inserting a 1 ohm resistor in the R13 location. The jumpers and resistor locations are shown in Figure 3-24.

3.10 VOLTAGE SUBSTITUTION CALIBRATION

Voltage substitution calibration is only available if Option 1 has been selected for Feature 3.

Provisions are made on the Bridge Completion Card to mount a 2- or 3-resistor divider in series with the voltage substitution signal input. This section describes the set up for voltage substitution calibration and how to determine divider values for each type.

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* NOTE *
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If a divider is not required or is undesireable, it will be necessary to short out resistors R20 and R21 to allow the calibration signal to reach K1.

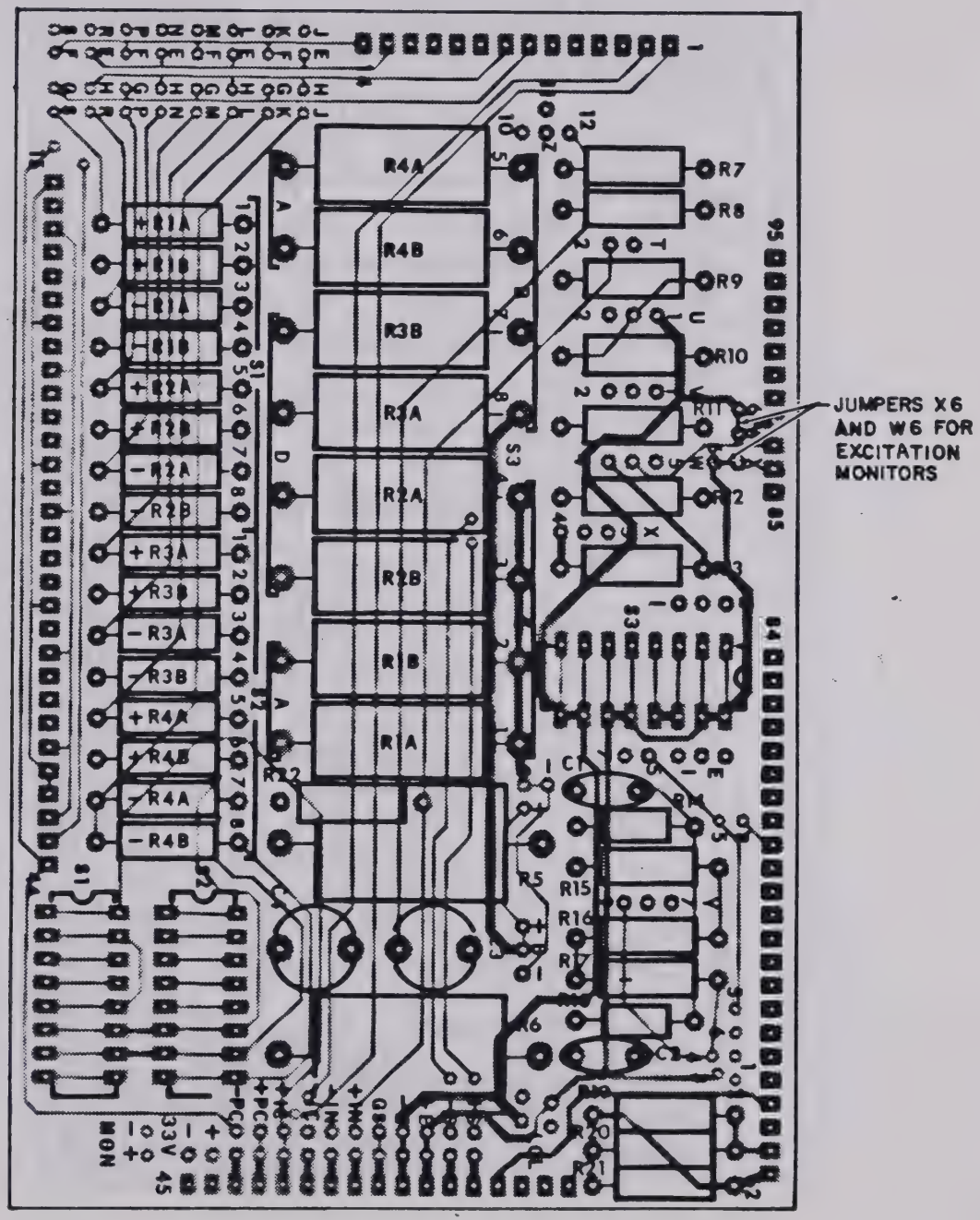


Figure 3-22 Excitation Monitor

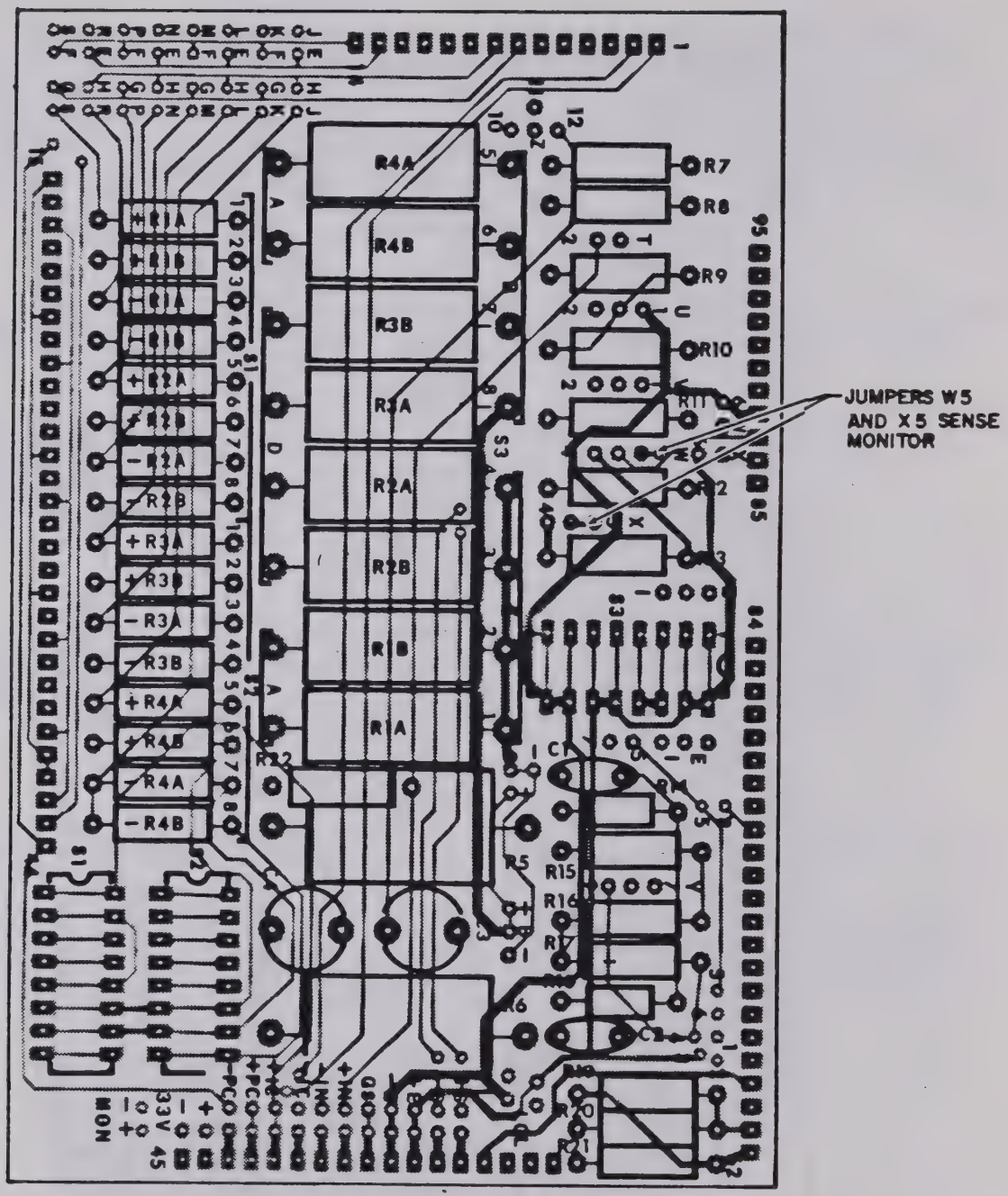


Figure 3-23 Sense Monitor

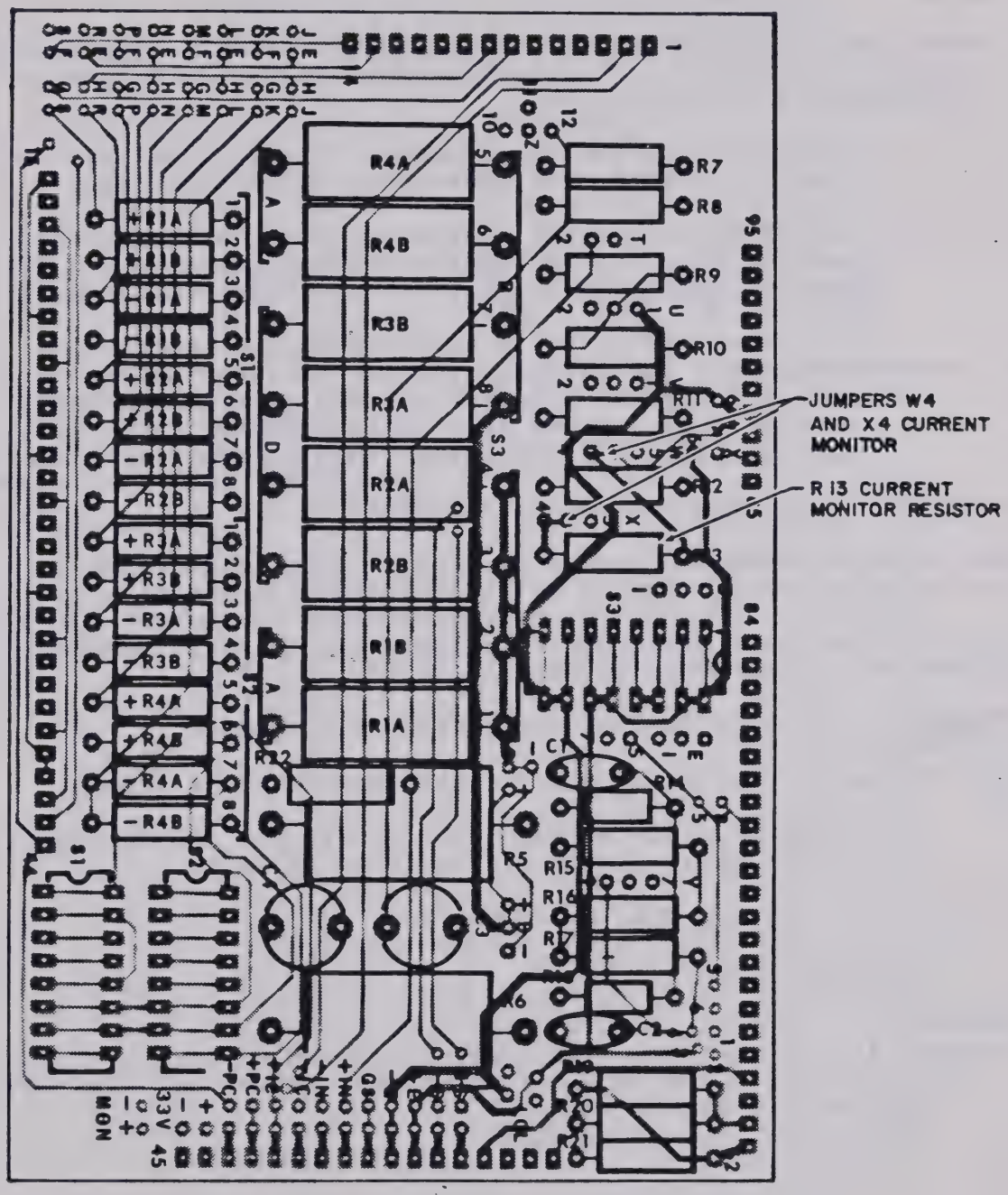


Figure 3-24 Current Monitor

3.10.1 System Connections

Connections to a system for voltage substitution calibration are shown in Figure 3-25. When making connections the following considerations are important.

1. The return or minus (-) output from the calibration source must be tied to the instrumentation common lead.

2. Amplifier return for each instrument in the system must be tied to the instrumentation common. For best results avoid "daisy-chaining" of amplifier commons.

3. If all channels are to be calibrated at once, then a separate voltage substitution calibration signal source should be provided between each 10-channel cabinet used and the calibration source. For this application "Daisy-chaining" should be strictly avoided.

3.10.2 Voltage Divider Calculation

The divider impedance should be greater than 10 kohm to minimize errors introduced by loading and wire resistance.

Calculations for the 2- and 3-resistor dividers are described in the following subsections.

3.10.2.1 Calculations for 2-Resistor Divider

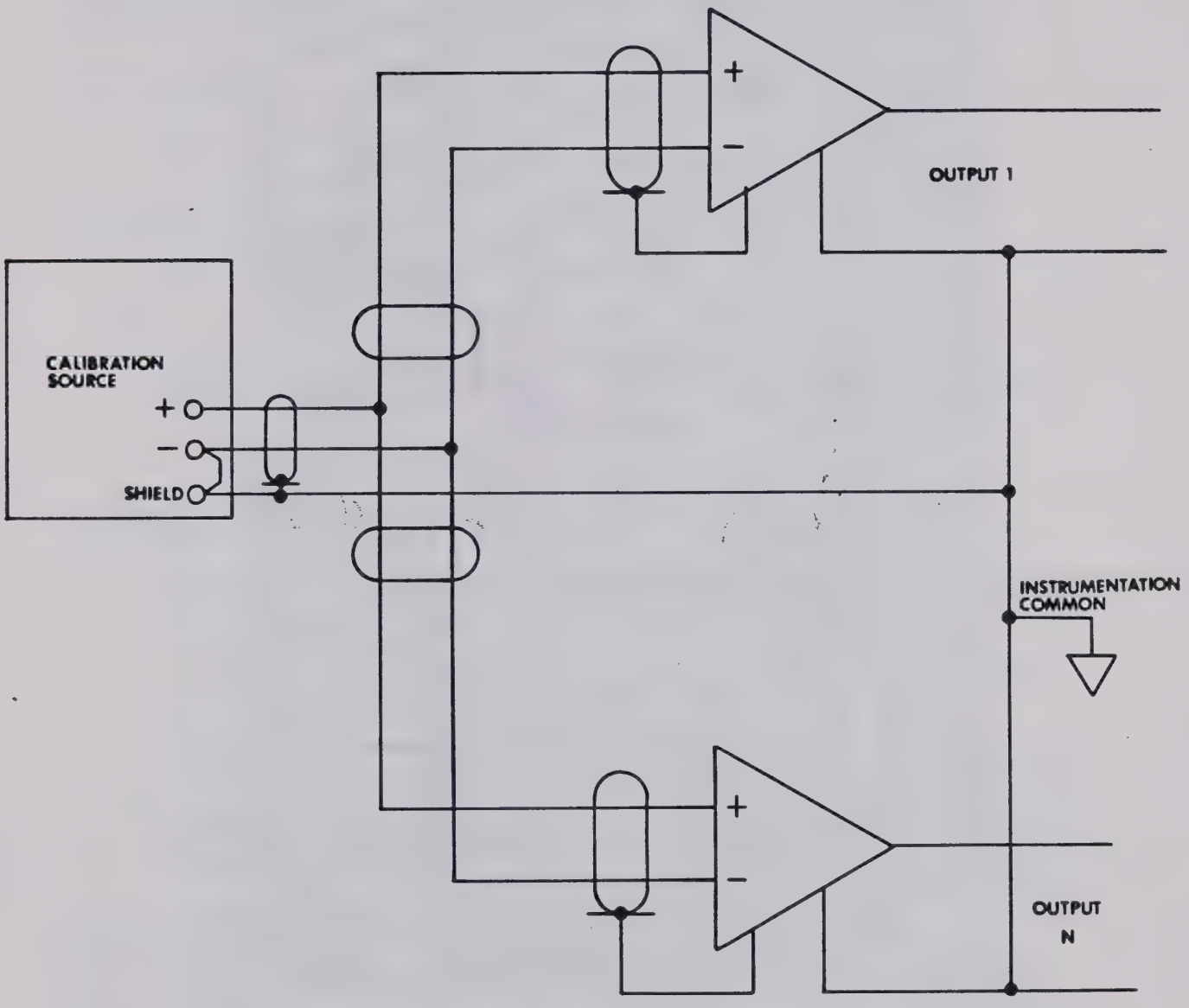
The following conditions must be observed for this set-up.

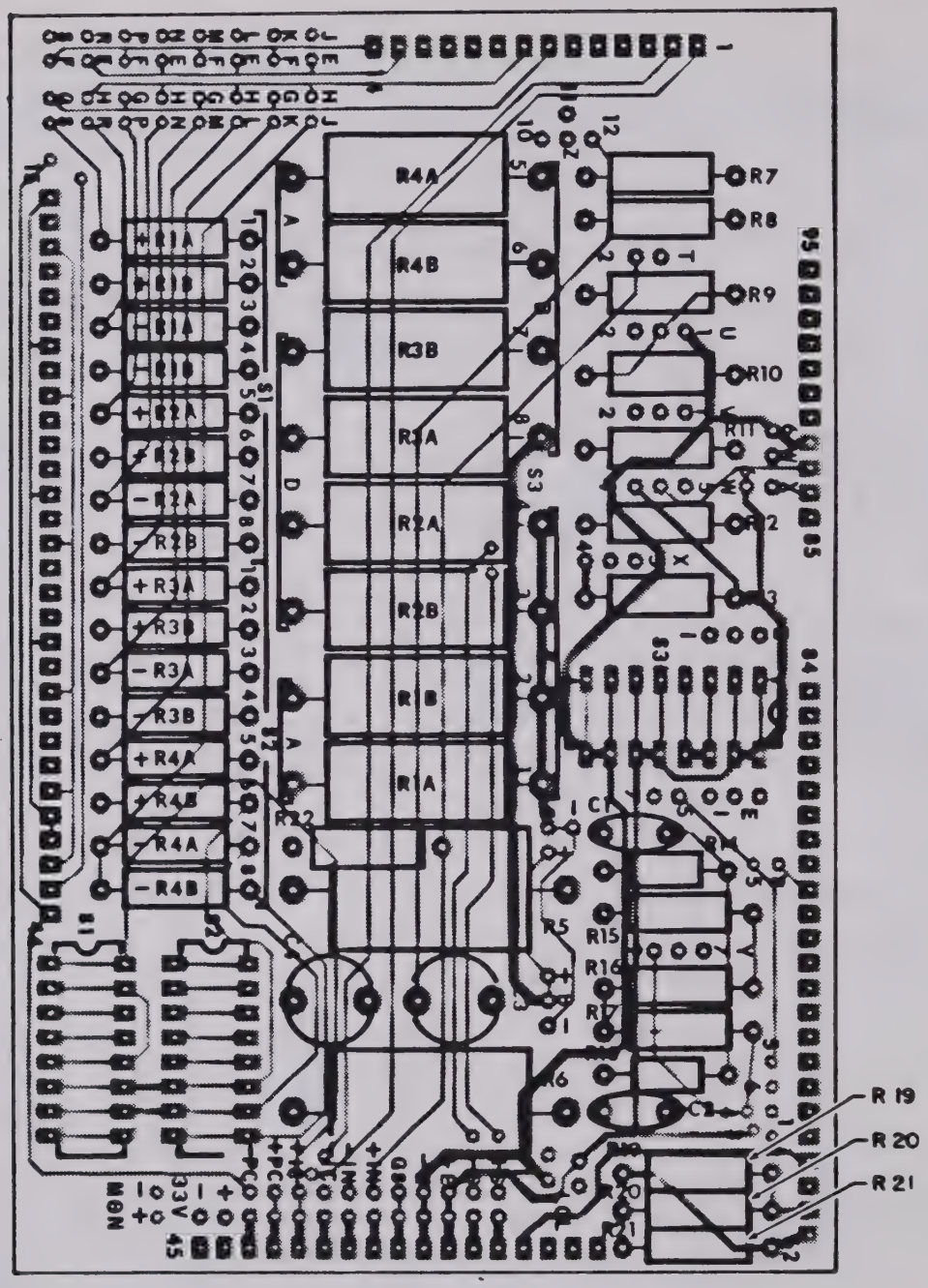
1. Place a jumper across R21. (Short out the resistor.)
2. (R19 + R20) must be greater than 10 kohm.

Resistor values can then be found from:

$$Eo/Ein = R19/(R19+R20) \qquad \text{(eq 19)}$$

Where:
Eo is the desired voltage across R19 in volts,
Ein is the given calibration source voltage in volts, and
R19 and R20 are in ohms.


CALIBRATION SOURCE
+
−
SHIELD
OUTPUT 1
INSTRUMENTATION COMMON
OUTPUT N



NOTE: If an attenuator is not used, R20 and R21 must be shorted.

Figure 3-25B Instrumentation Connections Voltage Substitution Calibration

3.10.2.2 Calculations for 3-Resistor Divider

The 3-resistor calibration divider has an advantage over the 2-resistor divider by supplying a balanced impedance to the amplifier input. It therefore more closely represents the output from a wheatstone bridge circuit.

Conditions for solution of these values are:

1. R20 = R21
2. (R20 + R21 + R19) is greater than 10 kohm.

Resistor values can then be found from:

$$Eo/Ein = R19/(R19 + R20 + R21) \qquad \text{(eq 17)}$$

Where:
Eo is the desired voltage across R19 in volts,
Ein is the given calibration source voltage in volts, and
R19, R20, and R21 are in ohms.

3.11 AC COUPLED INPUT

If an AC coupled input is to be used, the Bridge Completion Card must be configured as follows:

1. Cut the traces (on the reverse side) that short out resistors R5 and R6. (See Figure 3-26.)

2. Insert components in designated referenced locations on the Bridge Completion card as follows:

LOCATION	COMPONENT AND DESCRIPTION
R5,R6	1uF,50V,±10% mylar or polycarbonate capacitor
R14,R18	100 kohm, 1%, RN55C resistor

These values provide a -3 dB point of 1.6 Hz. Other circuit values may be used. However, for best results, resistances of R14 and R18 should be less than 100 kohm for gains greater than 50, and always less than 1 Mohm. Capacitors selected should be a low-leakage type. Avoid electrolytic and tantalum capacitors.

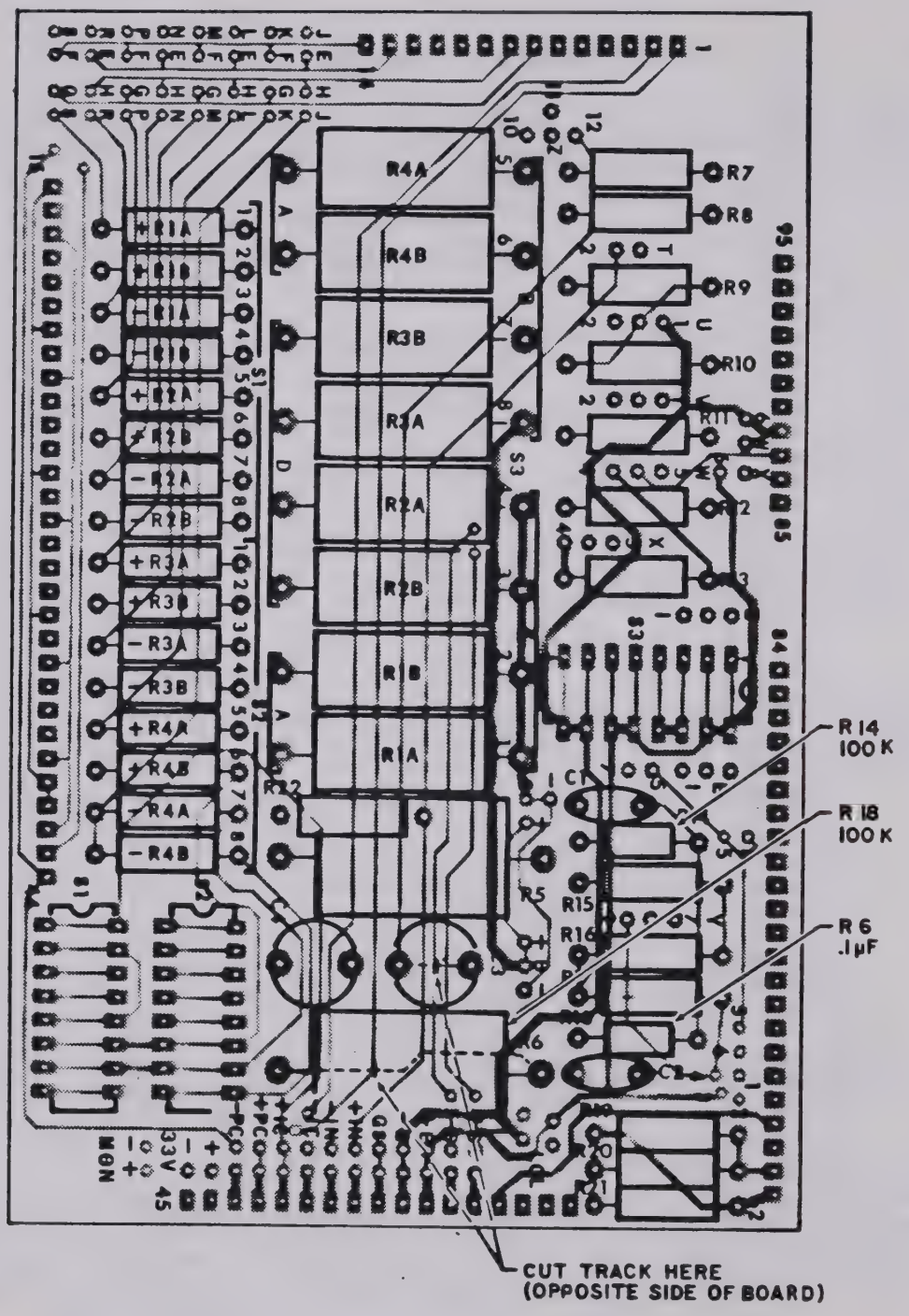


Figure 3-26 AC Coupled Input

3.12 VOLTAGE DIVIDER INPUT

Provisions are included in the Model 7600A for insertion of a voltage divider in series with the input to the amplifier section. With this divider, the user may obtain gains less than "1".

When using the voltage divider, the GAIN switch (on the 7600A) should only be set to positions lower than 20. Overall divider impedance should not exceed 1.5 Mohm.

The following subsections describe configurations for 10 to 1 and 100 to 1 dividers including necessary circuit adjustment procedures.

3.12.1 10 to 1 Voltage Divider

To configure the Bridge Completion Card for a 10 to 1 voltage divider, proceed as follows:

1. Sever the traces that short out R5 and R6. (See Figure 3-26.)
2. Insert components in designated referenced locations on the Bridge Completion Card as follows:

LOCATION	COMPONENT AND DESCRIPTION
R5,R6	1 Mohm resistor RN60C
R14,R18	110 kohm resistor RN55C
C3,C4	9-35 pF variable capacitor

These values provide a voltage division of approximately 0.099, or 10% low. The divider can be adjusted to a closer value by inserting 113 kohm RN55C resistors for R18 and R14, and placing a 50 kohm potentiometer in series with R5 and another potentiometer in series with R6, and adjusting these controls to obtain the desired voltage division ratio. The effective voltage divider circuit is illustrated in Figure 3-27.

3.12.2

To configure the Bridge Completion Card for a 100 to 1 voltage divider, proceed as follows:

1. Sever the traces that short out R5 and R6. (See Figure 3-26.)

2. Insert components in the designated referenced locations on the Bridge Completion Card as follows:

LOCATION	COMPONENT AND DESCRIPTION
R5,R6	1 Mohm resistor RN60C
R14,R18	11 kohm resistor RN55C
C3,C4	2-8 pF variable capacitor
C1,C2	330 pF ceramic disc capacitor

These values provide a voltage division of approximately 0.0099, or 1% low. The divider can be adjusted to a closer value by inserting 11.3 kohm FN55C resistors for R18 and R14; and placing a 50 kohm potentiometer in series with R5 and another potentiometer in series with R6, and adjusting these controls to obtain the desired voltage division ratio. The effective voltage divider circuit is illustrated in Figure 3-27.

3.12.3 Circuit Adjustments

After all the voltage divider components have been installed as described above, a final adjustment must be made. Connect the unit as shown in Figure 3-28 and proceed as follows:

1. Set the overall gain to 1, i.e., if the input divider is .1, then set the gain to 10.

2. Drive the +INPUT side of the amplifier from the signal source high side, and connect the -INPUT and guard shield side to ground.

3. If the potentiometer has been installed in series with R5, adjust the potentiometer to achieve the correct divider ratio. The gain can be adjusted by first applying a 0V input signal and adjusting the amplifier tape output to 0$\pm$1mV. Apply 10V dc to the input and adjust the potentiometers for a 10V output.

4. With a 100 Hz square-wave input, adjust C3 for the best output transient response.

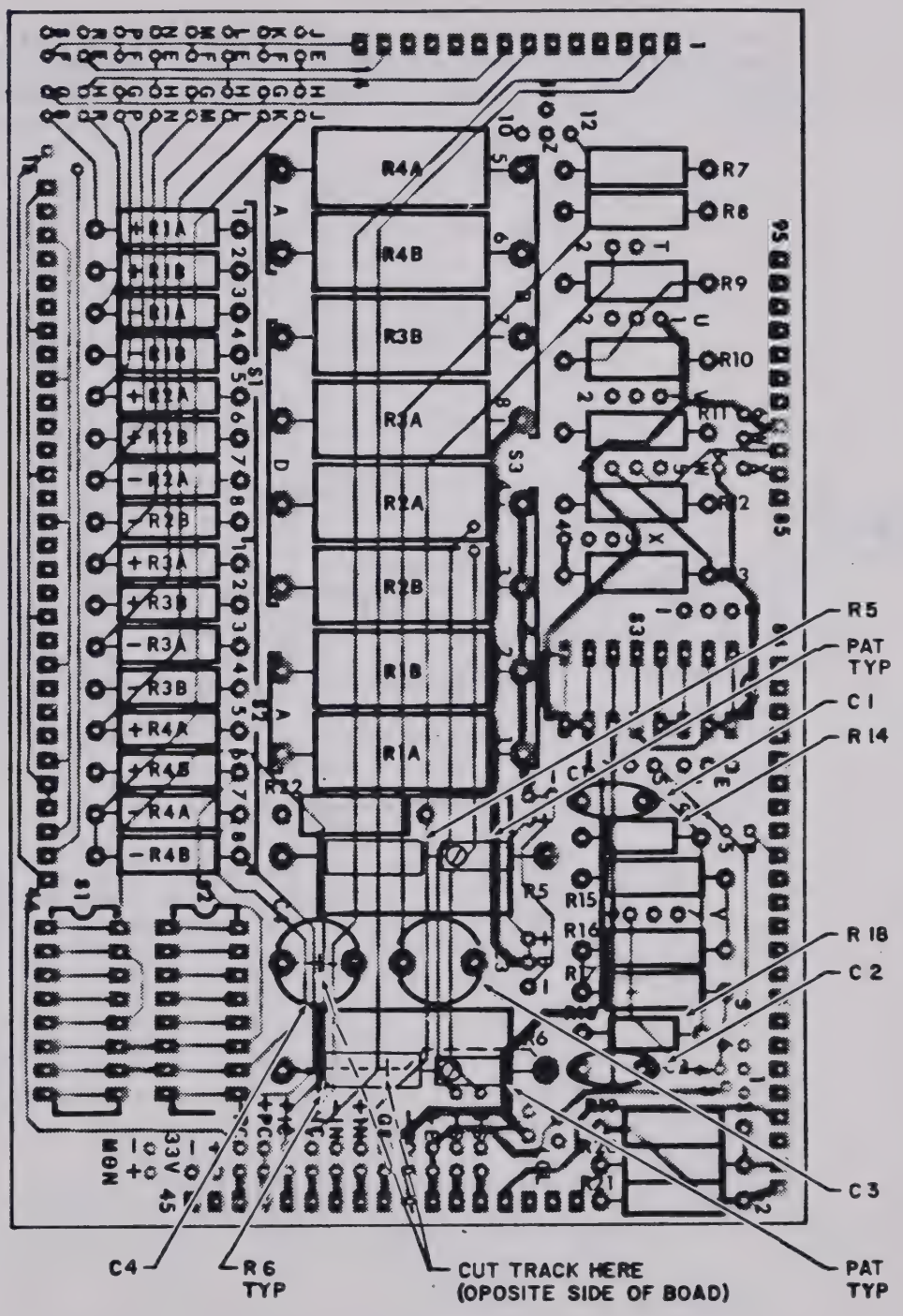


Figure 3-27 Voltage Divider Circuit

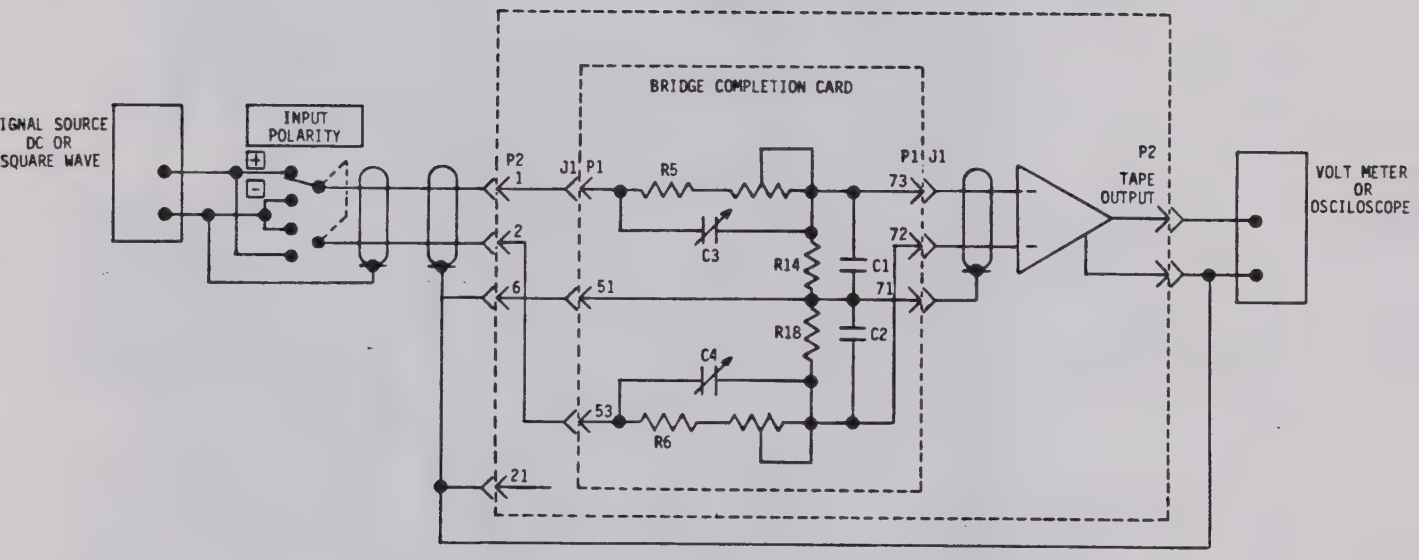


Figure 3-28 Adjustment Set-Up for Voltage Divider

5. Reverse the +INPUT and -INPUT leads to the amplifier and repeat steps 2 and 3 with the exception that the potentiometer in series with R6. and capacitor C4 must be adjusted.

3.13 ZERO PROCEDURE

When the 7600A is completely configured as described in previous subsections, the unit must be "zeroed". To zero the unit, follow the procedure below:

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All connections and adjustments for the zero procedure are made from the front panel of the 7600A.

1. Connect a DVM (digital voltmeter) to the tape output monitor jacks located on the front panel. Connect the DVM minus lead to the minus output monitor jack. If the DVM has a separate shield connection, this should be tied to the minus input on the DVM.

2. Set the input disconnect switch to the DISC position.

3. Set the amplifier GAIN switch to "1".

4. Adjust the TAPE Zero Control for a reading of 0V ±0.5 mV on the DVM.

5. Set the amplifier gain switch to 1000.

6. Adjust the RTI Zero Control for a reading of 0V ±0.5 mV on the DVM.

7. Repeat steps 3 through 6 until a reading of 0V ±1 mV is obtained for each gain step.

8. If the unit is equipped with a GALVO output, move the DVM leads to the GALVO output monitor jacks and adjust the GALVO Zero Control for a reading of 0V ±2 mV on the DVM.

9. Disconnect the test equipment and set the input disconnect switch to its connect position.

The unit may now be connected to the transducer and is ready for operation.

SECTION 4 THEORY OF OPERATION

4.1 General

The 7600A signal conditioning is a general purpose signal conditioner and amplifier used to condition signals from resistive devices which can be configured into a Wheatstone Bridge. The unit consists of four major sections which are divided into several subsections. The major sections are the instrumentation amplifier, excitation power supply, signal conditioning and auto zero. Figure 4-1 shows a simplified block diagram.

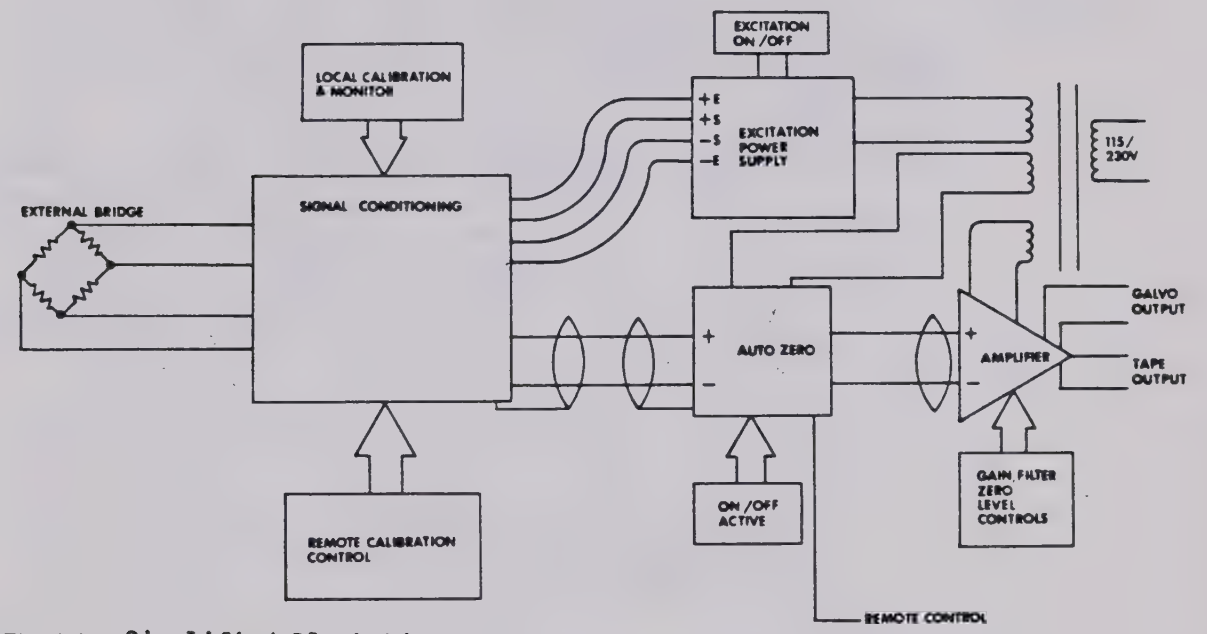


Fig. 4-1 Simplified Block Diagram

4.2 Amplifier Section

The amplifier section consists of the input amplifier, summing amplifier, varible gain amplifier, tape output amplifier, balance indicator, filter module, galvo output module, and power supplies. Figure 4-2 shows the Amplifier Block Diagram.

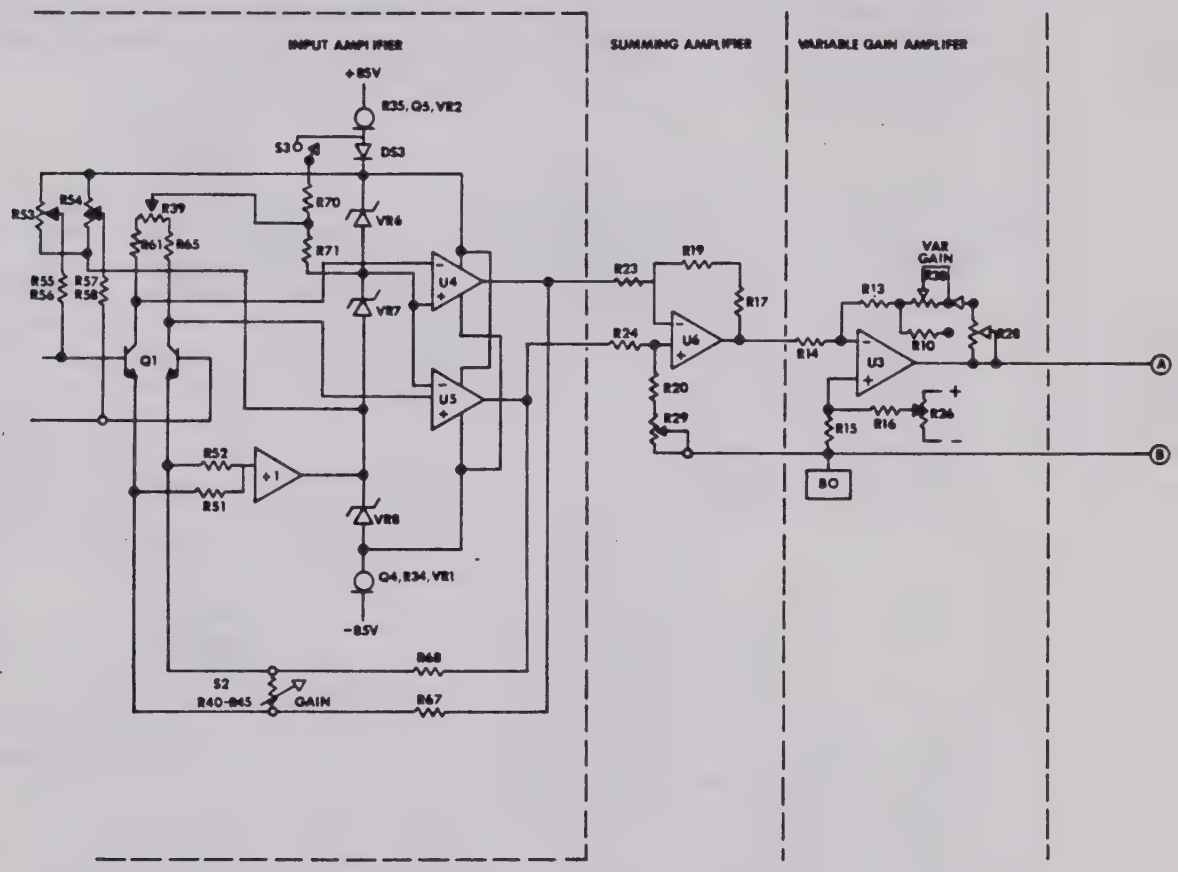


Fig. 4-2 Amplifier Block Diagram

4.2.1 Input Amplifier

The input amplifier is a differential input/differential output design. The input signal is applied to the bases of Q1. The amplified output signal is available at pin 6 of U4 and U5. The amplifier has a differential gain determined by R67, R68 and the resistor selected by the GAIN switch S2. The common-mode gain is set to unity.

4.2.1.1 Common-mode Signal Processing

The common-mode content of the input signal is carried through the input amplifier at unity gain. In order to achieve the extremely high common-mode input impedance (>2000M ohms), the input amplifier is bootstrapped by the common-mode signal. This is accomplished by deriving a floating power supply from a positive current source Q5, R35 and VR2, a negative current source Q4, R34 and VR1, and voltage regulators VR6, VR7 and VR8. The floating power supply is driven by a unity gain amplifier, Q2 and Q3 which is connected as a darlingtor transistor pair. The signal applied to the base of Q2 is equal to (E1 + E2)/2 where E1 and E2 are the two input voltages at the bases of Q1. With the inputs at 0V, the voltages listed on the schematic prevail. If a +10V common-mode signal is applied to the input, then the voltages in Table 4.1 will occur.

Point	0V Common-mode Signal	±10V Common-mode Signal
Bases Q1	0V	+10V
Emitter Q1	-.5V	+9.5V
Pin 6 U4,U5	-1V	+9V
Emitter Q2	-.5V	+9.5V
Emitter Q3	-1.5V	+8.5V
Collector Q4	-21.5V	-11.5V
Collector Q5	+18.6V	+28.6V

Table 4.1 Common-Mode Voltages

As can be seen in Table 4.1 all the voltages in the input amplifier increase by 10V, thus bootstrapping the input amplifier. The common-mode range of the input amplifier is ±50V.

4.2.1.2 Differential Signal Processing

When a differential signal is applied to the input amplifier the circuit will amplify this signal as determined by the feedback resistors comprised of R51, R52, R68, R67 and one of R40 thru R48. The open loop gain is determined by Q1, U4 and U5, and is approximately 10,000,000. This large open loop gain provides excellent gain stability and linearity for all gain steps. Assume a differential voltage of 1V and the gain set to 10, the following voltages in Table 4.2 will occur.

Signal Point	0V Differential Input	1V Differential Input
Junction CR8 & Base Q1	0V	0V
Junction CR9 & Base Q1	0V	+1V
Junction R50 & Emitter Q1	-.5V	-.5V
Junction R51 & Emitter Q1	-.5V	+.5V
Base Q2	-.5V	0V
Pin 6, U4	-1V	+5.5V
Pin 6, U5	-1V	-5.5V

Table 4.2 Differential Voltages

The differential input voltage forces a current to flow in R43, R51 and R52 where the equivalent resistance is 2K. This current must come from pin 6 of U4 and U5, thus creating a voltage drop across R68 and R67.

4.2.1.3 Input Protection

Input protection from overvoltage conditions is provided by VR3, VR4, CR8, CR9. CR8 and CR9 protects Q1 while VR3 and VR4 limits the differential voltage to +20V. CR4 - CR7 are optional diodes to provide additional common-mode protection above the rated specifications.

4.2.1.4 Controls and Adjustments

4.2.1.4.1 Input Bias Current

The input bias current is adjusted by R53 and R54. R54 sets the bias current for the + amplifier input. R53 sets the bias current for the - amplifier input.

4.2.1.4.2 RTI Zero Adjustment

The referred to input (RTI) zero adjustment is provided by R39. This adjustment has a range of approximately 100 uV. Coarse RTI zero adjustments are provided by R60 and R64. These are factory adjustments and do not need to be reset unless repairs are made to the instrument. R60 will correct for a positive zero error while R64 corrects for a negative zero error.

4.2.1.4.3 Temperature Compensation

R49 and R50 are selected to achieve a lower RTI temperature coefficient. Installing either of these resistors will require the RTI zero to be readjusted. The value of R50 or R49 is computed by the following equation.

$$R = 517.6 \div (e^{\div(TC/86.25)} - 1)$$

Where:

R = the required resistor value in ohms

TC = the absolute value of the temperature coefficient in uV/°C

Install R49 to correct for a positive temperature coefficient and R50 to correct for a negative temperature coefficient.

4.2.1.4.4 Input Disconnect Switch

When the switch is in the disconnect position, the positive (+) amplifier input is disconnected from the signal source and connected to the negative (-) amplifier input which supplies a (0)V differential input to the amplifier. It also removes the short from DS3 allowing it to illuminate.

4.2.1.4.5 Gain Switch

The Gain Switch selects the desired gain setting. The two pole switch allows a Kelvin measurement of the gain resistors which reduces the effect of the switch contact resistance on the gain setting. The gain of the amplifier may be set to any desired value by selecting an appropriate gain determining resistor. The following equation defines this relationship.

$$RG = 200/(11G - 11)$$

Where:
RG = gain setting resistor in ohms
G = desired voltage gain

4.2.2 Summing Amplifier

The Summing Amplifier consists of U6 and resistor network R23, R24, R20, R19 and R17. The circuit is used to subtract out the common-mode signal processed by the input amplifier. Ideally the circuit has a common-mode gain of 0 and a differential gain of 0.2. R29 is used to set the common-mode gain to 0.

4.2.3 Variable Gain Amplifier

The Variable Gain Amplifier provides the variable gain circuit, overall gain calibration and amplify the differential signal from the summing amplifier. The circuit is a classical inverting gain stage. R38 is the varible gain control and R28 is the overall amplifier gain trim which sets the overall gain when the CAL switch is in the CAL position. R26 is an internal zero control which is used to remove any offset developed by the variable gain control. The gain of the summing amplifier and variable gain amplifier combined is set at -0.9091 and can be increased to -2.5 by the variable gain control.

4.2.4 Tape Output

The Tape Output consists of U2 and its associated circuitry. The circuit is a configured as a negative gain amplifier with the gain set at -1.0. R7 and R8 determine the gain. R9 and C2 provide isolation from capacitive loads and R106 protects U2 under a short circuit condition. R37 is the tape level control and R36 is the tape zero control. The range of R36 is determined by R6 and may be changed by replacing R6 with another value per the following equation.

$$R6 = 280000/E$$

Where:
R6 is in ohms
E is the desired peak zero control range in volts.

4.2.5 Balance Indicator

The Balance Indicator consists of U1 and associated circuitry. U1 is connected as an inverting gain amplifier with a gain of 1000. The LED is placed in the feedback loop. A 1mV input to R2 will produce 1V at the junction of R1 and R3, this in turn produces about 1mA of current to flow in the BAL LED lighting it. The LED glows green when the current flows in one direction and glows red for the other direction. R25 is the zero control for the balance indicator and is adjusted by first adjusting the taoe output to 0V output and then adjusting R25 so the LED is not lit. The LED will glow red when the tape output is positive and green when it's negative.

4.2.6 Filter Module

The Filter Module is a self contained unit which plugs into the 7600A main PC board. The main PC board contains a jumper block with two shorting blocks. This allows the user to connect the filter's output to the tape output, galvo output or both. The jumper block also allows the filter to be bypassed. The filter module itself is a standard positive-gain, 2-pole, low-pass filter design. The filter consists of an AR301 and associated circuitry. The filter switch S301 selects both capacitors and resistors. The capacitors are used for decade ranging while the resistors select ranges within the decade. Other filter cutoff frequencies may be obtained by scaling the resistors and/or capacitors.

4.2.7 Galvo Module

The Galvo Module contains the galvo level and galvo zero controls and is similar to the tape output. The galvo module contains a negative unity gain amplifier. The galvo zero control provides a $\pm$10V range and is derived from $\pm$6.2V references provided by VR202 and VR201. The range of the control is set by R212. Other ranges can be set by changing the value of R212. The equation follows.

$$R212 = 108000/E$$

Where:

R212 is in ohms
E is peak output voltage range in volts.

The amplifier AR201 drives a current amplifier to increase the current drive to above 100 mA. The current amplifier has a current gain above 1000 and a voltage gain of unity. The current amplifier is symetrical in design, therefore only the positive section will be described. The output of AR201 (pin 6) drives the base of Q206. This transistor is an emitter follower which provides current gain and bias stability for the output pass transistor Q202. Q205 provides constant

current to Q206 and base drive to Q202. Transistor Q203 provides current limiting for Q202. Current limiting is set by R203 and R204. The following equation describes the relationship between R204 and the output current limit. It can be expected that the output current will be linear to within 80% of the set current limit value.

$$R204 = (.55 - 4.3*I)/I$$

where:

I = the current limit in amps
R204 = current limit resistor in ohms

CR204 and CR201 protect Q206 and Q203, respectfully, under an output short circuit condition.

4.2.8 Power Supply

There are four power supply voltages required by the amplifier. These are ±85V and ±16V. The 85 volt supplies are unregulated and are obtained by a half wave rectifier (CR2,CR3) on a separate transformer winding. C7 and C8 are their respected filter capacitors and C11 and C12 reduces the switching spikes caused by C7 and C8. The ±16V supplies are derived from a full wave bridge rectifier (BR1) and adjustable, complimention, linear voltage regulators connected in a tracking mode. The output voltage is determined by R30-R32.

4.3 Excitation Power Supply

The Excitation Power Supply is a precision, low-noise, low-drift device capable of operating in a constant current or voltage mode. In the constant voltage mode, the supply contains sense leads which are used to assure the proper voltage at the load, thus reducing the effects of long signal lines. The excitation power supply contains three major subsections. They are power supply and pre regulator, reference and output amplifier. Figure 4-3 shows the block diagram for the excitation power supply.

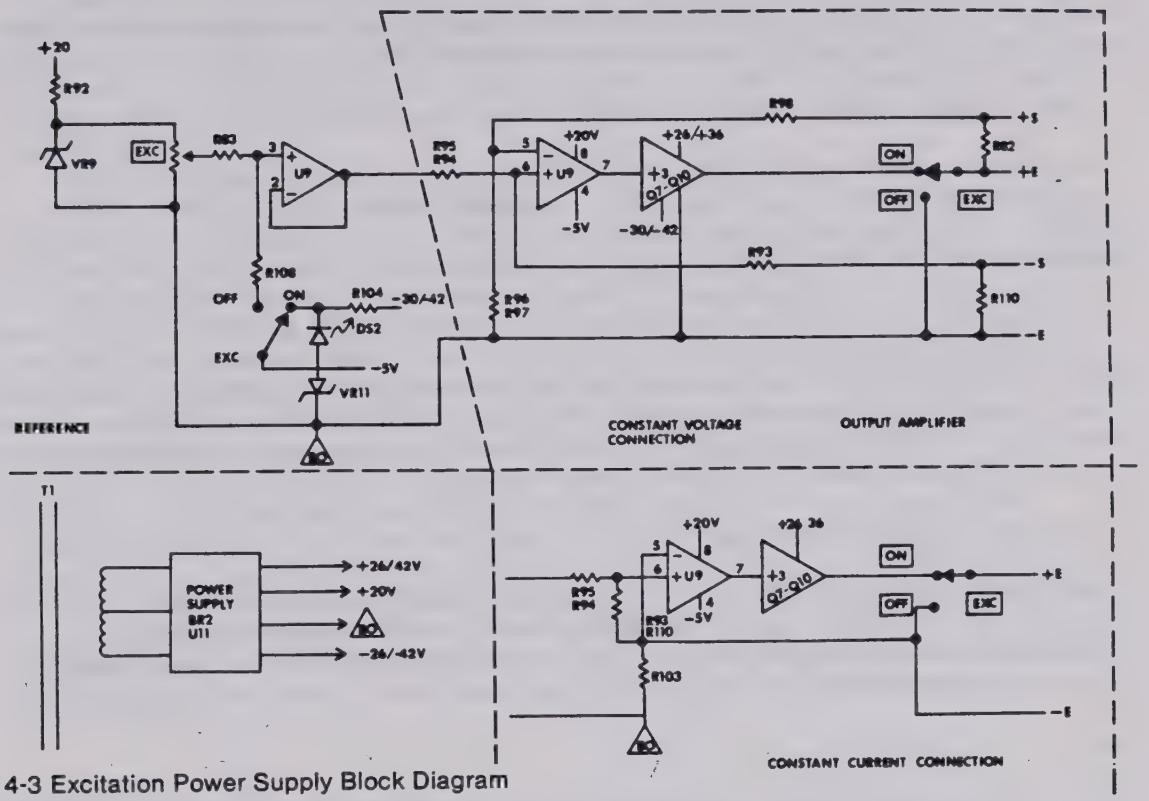


Fig. 4-3 Excitation Power Supply Block Diagram

4.3.1 Power Supply

The Power Supply for the excitation supply is generated from a separate, shielded, isolated winding from the transformer T1. BR2 is a full-wave bridge rectifier and C34 and C37 are its associated filter capacitors. C32 and C33 reduce the switching spikes generated in BR2. The positive unregulated power supply is used to generate +20V thru the linear voltage regulator U11. R91 and R90 determine the output voltage. For the 30V excita-

tion option, feature four, option one R112 and VR10 limit the input voltage to U11 to 30V. -5V is generated by R104 and VR11. The excitation on/off indicator is in series with R104 and is shorted by S7 when the excitation is on.

4.3.2 Reference

The Reference voltage for the excitation power supply is developed by the band-gap, reference zener diode VR9. R92 limits the current thru VR9 to a save value. The reference voltage from VR9 is adjusted by the front panel EXC potentiometer (R77). The output from the excitation potentiometer is applied to a unity gain buffer amplifier (U9 pins 1, 2, 3). The output of this amplifier (pin 1) drives the output amplifier. When the excitation switch is in the OFF position, it supplies -5V thru limiting resistor R108. This current in effect turns the excitation supply off, that is, the output of the excitation supply (collector Q10) becomes -.7V.

4.3.3 Output Amplifier

The Output Amplifier contains two sections, the error amplifier (U9 pins 5, 6, 7) and the buffer (Q7 - Q10). The output amplifier may be connected for constant voltage or constant current operation.

4.3.3.1 Buffer

The Buffer Amplifier provides a voltage gain of about 3 and a current gain over 1000. The input of this amplifier is the base of Q7 and is driven from the output of the error amplifier (U9 pin 7). The feedback for the buffer amplifier is thru R84 to the emitter of Q7. Q9 and Q10 are a darlington connected PNP stage which supplies addition current and voltage gain. The current supplied to the transducer is delivered by the series pass element Q10. R99 monitors the total current flow and when the voltage accrues R99 reaches .55V, Q8 turns on which removes the base drive to Q9 which in turn shuts the regulator down.

4.3.3.2 Error Amplifier Constant Voltage Mode

The Error Amplifier supplies a correction voltage to the buffer in order to maintain a constant voltage at the sense points. This is accomplished by the feedback scheme and the matching of R98 to R93 and R95 to R96 and R94 to R97. The gain of the output amplifier is 3.32 for the 15V excitation unit and 5.64 for the 30V excitation option. R82 and R110 limit the excitation voltage to a safe level if one or both of the sense leads are open.

4.3.3.3 Error Amplifier Constant Current Mode

In the constant current mode, the feedback network is reconfigured as shown in the block diagram 3-3. The Error Amplifier provides a correction voltage to the buffer to assure a constant current is supplied to the transducer. The conversion factor is:

$$I = E/65$$

Where:

E = reference voltage pin 1 of U9 in volts

4.4 Signal Conditioning

The Signal Conditioning section provides the interface between the transducer, amplifier and excitation power supply. Calibration and monitor circuits are also provided in the signal conditioning circuit. All circuits in the signal conditioning section are passive circuits and can be easily traced on the bridge completion schematic. See drawings in appendix A. Operation of these circuits have been discussed in sections two and three of this manual. There is one active element in this section, Q11. Q11 is used to limit the current thru DS2 to about 20 mA which protects DS2 when more than one calibration relay is active.

4.5 Auto Zero

The Auto Zero board contains four major subsections. They are power supply, DAC, digital and reference. The auto zero circuit senses the amplifier's output prior to the filter and when commanded, generates a voltage of opposite polarity to the error and inserts the voltage at the amplifier's input. Figure 4-4 shows the Auto Zero Block Diagram.

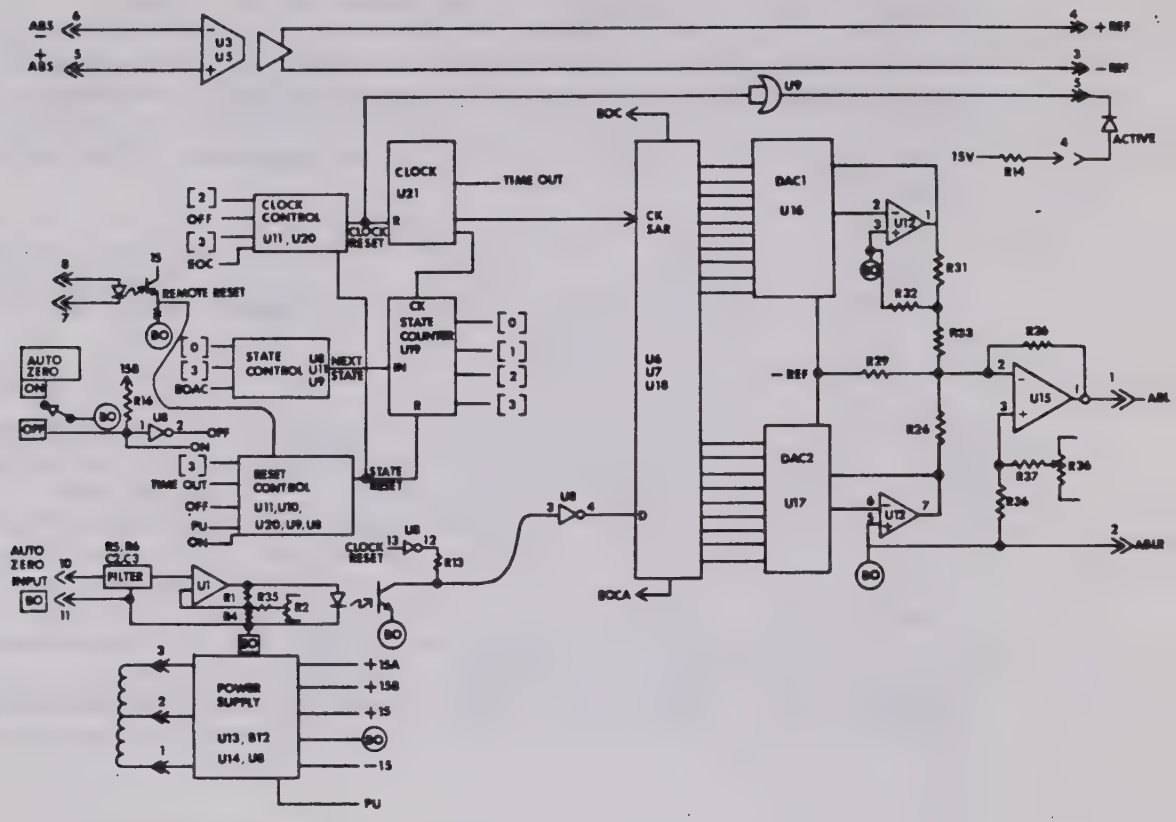


Fig. 4-4 Auto Zero Block Diagram

4.5.1 Power Supply

The Power Supply is derived from an shielded, secondary winding from the power transformer through full wave bridge rectifier BR1. The rectified voltage is then smoothed by C15 and C16 and regulated to +15 and -15V by linear, series regulators U13 and U14. There are three +15V supplies. +15V supplies voltage to the op amps, U3, U5, U12 and U15. The +15A supplies voltage to the DAC's, U16 and U17. +15B supplies voltage to the digital ICs, U8, U9, U10, U11, U20, U19, U21. The +15B also contains an optional battery BT1 which supplies power to the digital circuits when ac power is removed. When the battery is installed, the digital circuit remembers the last zero setting just before the power was removed. BT1 is a ni-cad battery whose charge is maintained by R15. CR4 prevents the battery from being discharged when the AUTO ZERO switch is in

the OFF position and ac power is removed. U8 pins 8 and 9 provide a power up (PU) pulse to reset the digital circuits when ac power is applied. The PU pulse is about five seconds long and is a high to low signal. At power up, the circuit will perform the following actions depending on the AUTO ZERO switch setting and if the battery is installed. Table 4.3 describes this action.

AUTO ZERO SWITCH SETTING	BATTERY INSTALLED	STATE	POWER UP ACTION
Off	X	X	DAC placed in center of its range.
On	No	X	Auto zero is performed at power up.
On	Yes	3	No action, old zero value used.
On	Yes	Any state but 3.	Auto zero is performed at power up. This action is only performed if the battery has failed to preserve the last zero value.

X = Don't care

Table 4.3 Power Up Actions

4.5.2 Reference

The reference voltages for the auto zero board are provided by an instrumentation amplifier (U3, U5). The amplifier's input measures one of several system voltages determined by jumpers on the bridge completion card. Typically, the amplifier will measure the bridge excitation voltage. R9, R10 and R11 is a 3 to 1 voltage divider which is used to divide the input signal and keep U3 within a linear range. U3 buffers the output of the divider. U5 pins 1, 2, 3 subtract out the common-mode content of the input signal and references the input to circle Bo. U5 pin 5, 6, 7 inverts the voltage at pin 1 of U5. Pin 1 of U5 equals 1/3 of the input voltage and pin 7 of U5 equals -1/3 of the input voltage. Pin 1 of U5 becomes the + ref signal and supplies the reference to the DAC's and front panel BAL control. Pin 7 of U5 supplies the negative (-) ref to the BAL control.

4.5.3 DAC

The DAC sections include U16, U17, U12 and U15 and is a precision digital-to-analog converter with resolution of one part in 500000. This high resolution is accomplished by using two 10 bit DAC's U16 and U7. The output current from each DAC is converted to a voltage by U12. The voltage at pin 1 and 7 of U12 is between 0 and 1/3 of the excitation voltage as determined by the digital control word on the DAC's input.

$$Vout = Vref \left(\frac{A1}{2} + \frac{A2}{4} + \frac{A3}{8} + \cdots + \frac{A10}{1024}\right)$$

Where:

A1-A10 = the digital inputs and A1 = MSB, A10 = LSB and A1-A10 = 1 if input is high (+15V) and 0 if input is low (0V)

Vref = Voltage at pin 15 of U16 and U17

Vout = Voltage at pin 1 and 7 of U12

The output voltages from U12 are converted to a current and summed into U15 pin 1, 2, 3. R28 provides the current from U12 pin 7, R31, R32, R33 provides the current from U12 pin 1, and R29 provides a bi-polar offset. This current is again transfered to a voltage by U15. Pin 1 of U15 varies between +1/3 of the excitation voltage to -1/3 of the excitation voltage. This voltage is again divided by a 22 to 1 divider located on the bridge completion card. The total transfer function for the DAC's to pin 1 of U15 is:

$$Vout = Vref * (2 * (A1 + A2 + A3 + \cdots + A10) + .00166 * (B1 + B2 + B3 + \cdots + B10) - 1)$$

Where:

Vout = voltage at pin 1, U15
Vref = voltage at pin 15, U16

A1-A10 = Digital inputs to DAC2, U17, A1 = MSB, A10 = LSB
B1-B10 = Digital inputs to DAC1, U16, B1 = MSB, B10 = LSB

4.5.4 Digital Section

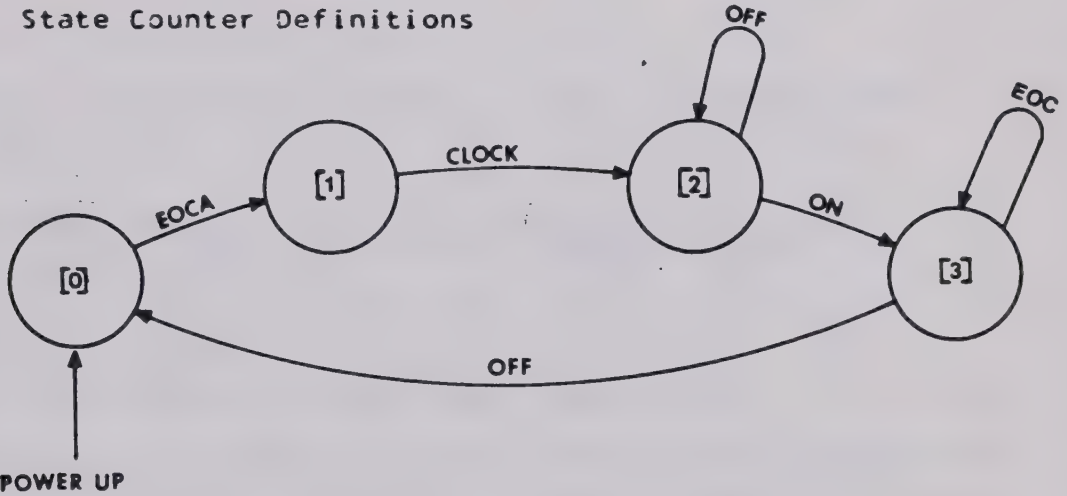
The Digital Section supplies the required digital inputs to the DAC's in order to zero the amplifier. The digital section performs a (successive) approximation conversion by comparing the output of the system instrumentation amplifier to 0V. This is accomplished by several subsections. They are comparitor, remote auto zero input, clock, state counter, reset control, next state control and clock control.

4.5.4.1 State Counter

The State Counter is the heart of the digital section. It determines the specific action of the circuit. There are four states as defined by Table 4.4. The selected state is controlled by U19 which is a counter with decoded outputs. The clock input (pin 14) advances the counter to the next state if the enable input (pin 3) is high. The reset input (pin 15) resets the counter to state (0) independent of the clock or enable inputs. The finite state diagram Figure 4-5 shows the behavior of the state counter.

STATE	NAME	FUNCTION
(0)	Reset	Reset U6, U7, U18
(1)	Center of range	Set MSB of U18 high all others low
(2)	Off	Stop if off, continue if ON
(3)	Auto zero	Complete auto zero and Stop

Table 4.4 State Counter Definitions



Power up

EOCA = pin 11, U18
Clock = one clock pulse to pin 14, U19
OFF = auto zero switch set to OFF
ON = auto zero switch set to ON
EOC = pin 11, U6

Figure 4-5 Finite State Diagram For The State Counter

The state counter is controlled by the state control logic, reset logic and clock control logic.

4.5.4.2 State Control, Reset and Clock Control Logic

The State Control Logic controls the enable input (pin 13) of the state counter (U19). The Reset Control Logic controls the reset input (pin 15) of the state counter (U19). The Clock Control Logic controls the reset input (pin 12) of the clock (U21). These logic functions are straightforward, discrete logic designs and their circuit behaviors are described in Table 4.5.

Step	State	Auto Zero Switch	U8 5	U8 6	U11 9	U11 10	U11 12	Next State Output U11 - 11
22.1	(0)	X	0	1	1	1	0	1
22.1	(0)	X	1	0	1	0	0	0
22.2	(1)	X	X	X	0	0	0	0
22.3	(2)	ON	X	X	0	0	0	0
22.4	(3)	X	X	X	0	0	0	0

X = Don't Care

Clock Control Logic

Step	State	Auto Zero Sw	Remote Auto Zero	PWR Up	U11 12	U11 13	U11 11	U11 6	U11 5	U11 4	U20 11	U20 12	CLK RST U20-13
23.1	(0)	ON	NO	NO	0	0	0	0	X	0	0	0	0
23.2	(2)	ON	NO	NO	1	0	0	0	X	0	0	0	0
23.3	(2)	OFF	NO	NO	1	1	1	0	X	0	0	0	1
23.4	(3)	OFF	NO	NO	0	1	0	1	0	0	0	0	0
	(3)	OFF	NO	NO	0	1	0	1	1	1	0	0	1
23.5	(1)	OFF	NO	NO	0	1	0	0	X	0	0	0	0
	(1)	OFF	YES	NO	0	1	0	0	X	0	0	1	1
23.6	(1)	OFF	NO	YES	0	1	0	0	X	0	1*	0	1

*During power up only, return to 0.5 seconds after power is applied.

X = Don't care.

Table 4.5 Next State Control Unit

4.5.4.2.1 State Control Logic

The State Control Logic allows the state counter to advance to the next state. State 0 or EOCA is high, or in state 1.

4.5.4.2.2 Clock Control Logic

The Clock Control Logic resets the auto zero clock, that is, turns it off. A high signal at pin 12 of U21 resets the clock. The clock is turned off if the state counter is in state 2 and the AUTO ZERO switch is off, or if the state counter is in state 3 and EOC is high. The state counter will advance to the next state unless the clock is running and pin 13 of U19 is high.

4.5.4.2.3 Reset Control Logic

The Reset Control Logic resets the state counter to state 0 and resets the system clock. The reset occurs given any of the following conditions.

1. Power up with AUTO ZERO switch in OFF position.
2. Power up with AUTO ZERO switch in ON position and in states (0), (1) or (2).
3. Remote auto zero input while the AUTO ZERO switch is in the ON position.
4. A time out signal while in State (3). This is an error condition and normally will not occur.

The output of the Reset Control Logic, pin 10 of U9, is a 100 ms wide pulse or the duration of the remote auto zero input. The remote auto zero input must be a pulse at least 100 ms wide. The unit will not begin the auto zero sequence until the remote signal is removed. See Table 4.6.

Step	State	Auto Zero	Power Up	Remote Auto Zero Command	U11 1	U11 2	U11 3	U10 8	U10 9	U10 10	U10 11	U10 12	U10 13	U10 4	U10 5	U10 6	U10 1	U10 3	U9 10	U9 8
21.1	(0)	ON	YES	NO	1	0	0	0	0	0	0	1	0	1	1	1	1	1	10	8
21.2	(3)	OFF	YES	NO	0	0	0	0	1	0	1	1	1	0	0	1	0	0	P	P
21.3	(3)	OFF	NO	NO	0	0	0	0	1	0	1	1	1	0	0	0	0	0	P	P
21.4	(3)	ON	NO	NO	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0
21.5	(2)	ON	NO	YES	1	1	1	0	0	0	0	0	0	0	1	0	1	0	1	0
21.5	(2)	OFF	NO	YES	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0

1 = 15V
0 = 0V
P = 100ms pulse zero positive going

Table 4.6 Reset Logic

4.5.4.3 Clock

The clock circuit is contained in U21. The basic clock frequency is set by R30 and C8. The various clock frequencies are described below.

U21 PIN	FREQUENCY
9	525 - 775 Hz
5	16.4 - 24.2 Hz or F9/32
14	2.05 - 3.03 Hz or F9/256
3	.032 - .047 Hz or F9/16384

Where F9 = the frequency at pin 9 of U21

4.5.4.4 Comparator

The Comparator (U1) is used to compare the output of the system instrumentation amplifier to 0V or square Bo. The comparator circuitry is operated from the system amplifier's power supply and its output (pin 6, U1) is coupled to the digital section of the auto zero board by optical coupler U2. The output of the system instrumentation amplifier is filter by a passive,

2-pole filter R5, R6, C2 and C3. The -3dB frequency of this filter is set to about 20 Hz and provides about a 30dB attenication at 60 Hz. The comparator is a precision amplifier with a gain of 25000 as determined by R1 and R4. Q1 and Q2 keeps U1 from going into saturation. R2 provides a means to set U1 to 0V output. The output of U1 drives the optical coupler U2.

4.5.4.5 Remote Auto Zero Input

The Remote Auto Zero Input (P101, pin 7 & 8) is used to command the unit to perform an auto zero function. This input is active only when the AUTO ZERO switch is in the ON position. The remote auto zero command is fed thru optical isolator U4 to the Reset Control Logic.

SECTION V

5.0 MAINTENANCE

This section is designed to aid the user in repairing a defective instrument and adjust the internal controls for proper operation. Calibration techniques required to properly adjust the internal controls are included in this section. Calibration techniques for specification verification are left to separate documents which are available from Dynamics.

5.1 Repair Of The Instrument

It is assumed the individual performing the repair task is familiar with linear, feedback circuits and digital circuits. Procedures will be given to break some complicated feedback paths to aid in the troubleshooting activity. One should first read the theory of operation section prior to beginning the troubleshooting activity. Discussion will be divided into three areas: the system instrumentation amplifier, excitation supply and auto zero section.

5.1.1 System Instrumentation Amplifier

To perform the required maintenance and calibration the user should construct or purchase from Dynamics a test harness which mates directly to the blue ribbon connector on the rear of the instrument.

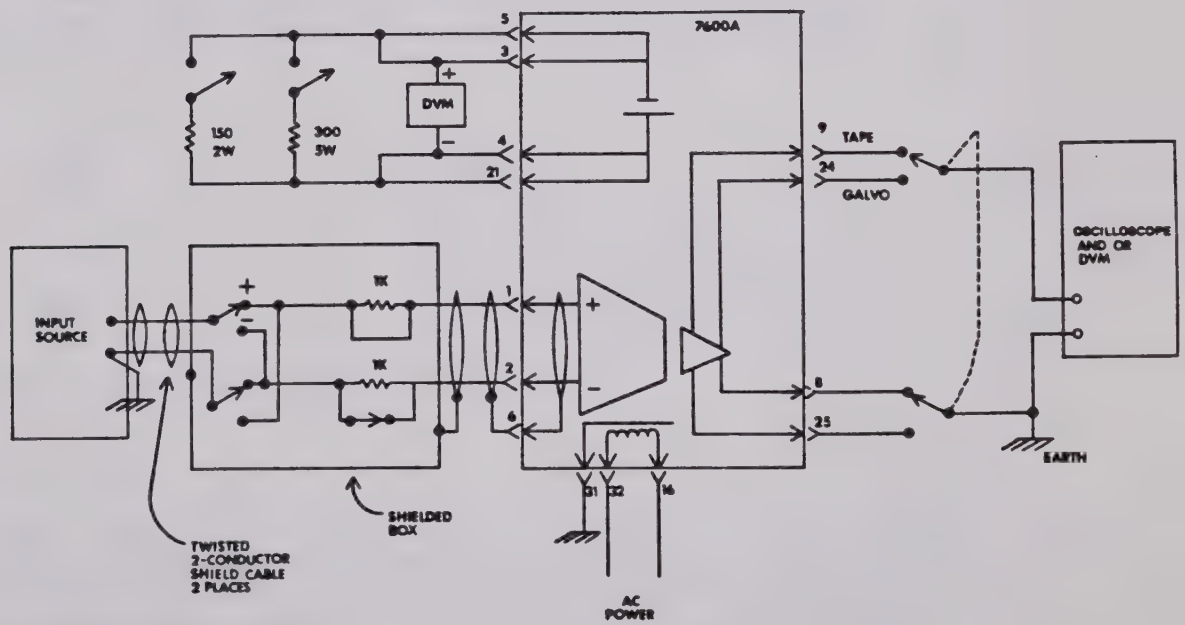


Fig. 5-1 Signal Test Connections

Connect the instrument per figure 5.1. The unit must contain a bridge completion card where the input signal is routed to the blue ribbon connector. This would be similar to a card configured for a 4-arm active bridge transducer as described in Section 3 or a Dynamics P/N 086625 Test Bridge Completion Board.

1. Set the unit to a gain of 10. Set CAL switch to the CAL position. Set INPUT DISC switch to the connect position. Set the FILTER switch to WB position. Adjust the TAPE LEVEL control fully clockwise. Set the function generator to produce a 1V p-p signal at 1kHz. Monitor the tape output with the oscilloscope.
2. Apply power to the unit. If the tape output is not 10V p-p then proceed with the Amplifier Functional Test, paragraph 5.1.1.1.
3. With the ac power set to 115V (or 230V for 230V power option), measure the power supply voltages per the following table. Use a DVM referenced to square 80.

+side of C10	(+22V)	+21.5 to +25V
-side of C9	(-22V)	-21.5 to -25V
+side of C8	(+85V)	+83 to +90V
-side of C7	(-85V)	-83 to -90V
Pin 3 of U8	(+16V)	+15 to +17V
Pin 3 of U7	(-16V)	-15 to -17V

The power supply voltages must be correct before the unit can be tested further. Loads may be removed from the power supply be removing the galvo and filter module and the integrated circuits. Care should be taken to assure the integrated circuits are placed back into their original sockets.

4. After the power supplies are verified, the amplifier can be signal traced to fina the section at fault. With the set-up conditions as stated in Step 1, continue as follows.

LOCATION TO BE MEASURED	CORRECT SIGNAL	IF CORRECT SIGNAL IS NOT PRESENT GO TO
Cathode CR8	1V p-p, 0Vdc	Step 5
Cathode CR9	0V p-p, 0Vdc	Step 5
Pin 6, U4	5V p-p, -1Vdc	Step 6
Pin 6, U5	6V p-p, -1Vdc	Step 6
Pin 6, U6	2.2V p-p, 0Vdc	Step 12
Pin 6, U3	10V p-p, 0Vdc	Step 13
Wiper R37	10V p-p, 0Vdc	Step 14
Pin 6, U2	10V p-p, 0Vdc	Step 15
Pin 24, P2	10V p-p, 0Vdc*	Step 16
	All OK	Perform Amplifier Functional Test, paragraph 5.1.1.1

*Only if galvo output option is supplied.

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5. The input signal is not reaching the input amplifier. Make sure the INPUT DISC switch is in the connect position. Signal trace from pins 1, 2 and 6 of P2 to the bases of Q1. Also verify that pins 1 and 2 of P2 are not shorted. Go back to Step 4.
6. The input signal is not being processed by the input amplifier correctly. The input amplifier contains multiple feedback paths which makes troubleshooting a difficult task.

7. Set the INPUT DISC switch to the DISC position and verify the DISC LED is on. If not, replace the LED. Verify the voltages listed on the schematic for the input amplifier. If the voltages are not correct, replace U4 and U5 and try again. If they are still not correct, place a short between the base of Q2 and square 8o. This supplies a known reference voltage for the common-mode amplifier.
8. Measure the voltage drop across R72 and R73 for about 25 mV. The drop across R73 must be greater than the voltage drop across R72. If this is not the case, remove the U4 and U5 and see if the voltage across R73 > R72. If not, the problem is in the current source Q5 or Q6. The voltage drop across R35 and R34 should be 2.6 to 2.8V. Replace parts as required and reinstall U4 and U5. Measure the other circuit voltages as shown below.

LOCATION	VOLTAGE
Base Q2	0V
Emitter Q2	-.5V
Emitter Q3	-1V
Pin 4, U5	-21V
Pin 3, U5	+14V
Pin 7, U5	+18V
Wiper R39	+14.2V
Pin 2, U4	+13V
Pin 2, U5	+13V

These voltages are all 1/2V higher than listed on the schematic because of the jumper placed on the base of Q2. If the voltages are not correct, then U4, U5, Q1, VR6, VR7, VR8, Q2 or Q3 are at fault and can be checked using standard troubleshooting techniques.
9. Remove the jumper from the base of Q2 to square 8o and check the outputs (pin 6) of U4 and U5 for the correct signal.
10. Other problems and solutions:
    a. Large dc offset, i.e. pin 6, U4 and U5 not at -1V. The problem may be R61, R65 has shifted value, Q1, or R68 and R67.
    b. Large gain error, i.e. peak to peak voltages wrong at pin 6, U4 and U5. Check the feedback loop R67, R68 and the resistor selected by the GAIN switch.
11. Return back to Step 4.
12. The summing amplifier is at fault. First replace U6. If the unit appears to have the wrong output signal or the common mode rejection is poor, check the accuracies of R23, R24, R20, and R19. These are 1% accurate parts where R23 is matched to R24 and R19 is matched to R20 within 0.05%. Go to Step 4.

13. The variable gain amplifier is at fault. First replace U3, then check the condition of the feedback resistor R12, R13, R10, R38, R28 and the other circuit elements. Go to Step 4.
14. The signal is not reaching the tape output amplifier. Check the condition of R37 and see that the internal filter switch or jumper blocks is in the correct position i.e. if the filter module is not part of the instrument, the jumper blocks or switch should be in the OUT position. The problem may also be in the filter module. By setting the jumper blocks or switch to the OUT position, the filter is bypassed. If the filter is at fault, the problem is most likely the op amp AR301. Go to Step 4.
15. The problem is in the tape output amplifier. First replace U2, then test the other circuit elements. Go to step 4.
16. The problem is in the galvo output. Adjust R215 so the wiper is at 0V and adjust R216 completely clockwise. Retest the output. If still bad, replace AR201. If it is still not working correctly, remove AR201 and drive pin 6 of AR201's socket with the signal source. The output (pin 7, P201) should be a wave form, the same as the signal source with a dc offset less than 200 mV. If the signal is not correct, the buffer must be repaired. Compare the circuit voltages to the schematic voltages and replace the defective parts. If the signal is OK, then the feedback is not correct. Check R218, R201, R219, R217 and R216. Go to Step 4.

5.1.1.1 Amplifier Functional Test

1. Apply a 1KHz sine wave signal to the amplifier's input.
2. Monitor the tape output.
3. If supplied, set the AUTO ZERO switch to the OFF position and adjust the BAL control to the center of its mechanical range.
4. Set the CAL switch to the CAL position.
5. If supplied, set the FILTER switch to the W.B. position and set the 2 jumper blocks to the IN positions.
6. Adjust the tape level control fully clockwise.
7. Set the GAIN switch to 1 and adjust the input signal to produce 20V p-p at the tape output.
8. Increase the GAIN switch setting and for each gain step adjust the input signal to produce 20V p-p at the tape output.
9. Set GAIN switch to gain 1 and adjust the input signal to produce 1V p-p.
10. Set the CAL switch to the VAR position.
11. Adjust the VAR GAIN control throughout its range. Make sure the gain increases smoothly as the control is turned clockwise and make sure the control mechanically operates smoothly.
12. With the VAR GAIN control fully clockwise measure the tape output voltage.

13. Set the CAL switch to the CAL position.
14. Adjust the input signal to produce 20V p-p at the tape output.
15. Adjust the tape level throughout its range. Verify the control operates smoothly and the output signal increases as the pot is turned clockwise. Also verify the output signal is less than 50 mV when the control is fully counter-clockwise. Set the control fully clockwise.
16. Set INPUT DISC switch to the DISC position. Verify the corresponding LED is lit and the output signal is zero.
17. Set the INPUT DISC switch to the connect position.
18. Connect the oscilloscope to the TAPE OUTPUT monitor points on the front panel and verify the same signal as at the tape output.
19. Set the input frequency to 0.5Hz and see that the BAL indicator is red when the tape output is positive and green when the tape output is negative.
20. Short the amplifier input and set the gain to 1000. Verify the tape zero control has a range of 80 mV and the RTI zero control has a range of 100 mV at the tape output.
21. If the galvo output is present, test the GALVO LEVEL control similar to Step 15 and the GALVO OUTPUT monitor points similar to Step 18. To perform these test the GALVO ZERO may have to be adjusted to produce 0V at the galvo output. Adjust the GALVO ZERO throughout its range and verify a range of -10V to +10V, limited to -11.5 and +11.5V.
22. If the filter is present, proceed with Steps 23 thru 26. For cutoff frequencies 30 Hz and above use an RMS measurement and for frequencies below 30 Hz use a peak to peak measurement.
24. Set the GAIN switch to 10 and CAL switch to CAL position. With the FILTER switch in the WB (wideband) position, adjust the input amplitude to produce 1 Vms or 1V p-p at the tape output at the curoff frequency desired.
25. Set the FILTER switch to the desired cutoff frequency. Measure and record the output amplitude. The output amplitude should be .63 to .79V rms or .63 to .79V p-p.
26. Repeat Steps 24, 25 and 26 until all positions except WB on the FILTER switch have been tested.

5.1.2 Excitation Power Supply

Connect the unit per Figure 5.1 and disconnect the load resistor. Set the unit for constant voltage mode. Adjust the ac power to 115 Vac or 230 Vac for the 230V power option. All measurements in this section are referenced to triangle Bo.

1. The power supply section must be operating properly before the other test can be performed. Measure the voltages listed below.

MEASUREMENT POINT	ACCEPTABLE VOLTAGE	POSSIBLE PROBLEM
+Side C34	26 to 36V for 15V exc 36 to 50V for 30V exc	Bad power transformer bridge rectifier or filter capacitor. Other circuits may be loading the power supply. They can be removed.
-Side C37	26 to 36V for 15V exc 36 to 50V for 30V exc	
Pin 3, U11	+18.5 to +21.5V	Bad U11.
Cathode, VR11	-4.9 to +5.3V	Bad VR11.

2. With the supplies working correctly, measure the voltage at the cathode of VR9 for +6.5 to 7.3V. If not, replace VR9 or look for loading on VR9 from other sources such as the excitation potentiometer R77.
3. Measure the voltage at pin 3 of U9 and adjust the excitation control (R77) throughout its range. The voltage at pin 3 of U9 should vary from 0V to the reference voltage, cathode of VR9. If not, remove U9 and try again. If OK replace U9. If not, look for an open or bad potientometer R77 or some other loading effect.
4. Measure the voltage at pin 1 of U9 and adjust the excitation control R77 throughout its range. The voltage at pin 1 of U9 should vary from 0 ± 0.01V to the reference voltage, cathode VR9. If not, replace U9.
5. Measure the excitation voltage, i.e. the output of the excitation power supply. Adjust the excitation control throughout its range. The output voltage should vary from 0 ± 0.1V to +16 ± 1V for the 15V excitation option or from 0 ± 0.1V to +32 ± 2V for the 30V excitation option. If the output operates correctly proceed to the excitation power supply functional test (Paragraph 5.1.2.1.).
6. The problem is in the error or buffer amplifier. fier. Remove J9 and place a 10K ohm potentiometer from the +20V to triangle Bo with the wiper connected to the base of Q7. Adjust the pot so the base of Q7 is at +5V. The excitation output voltage should be about 15V ± 2V. If the voltage is correct, place a 150 ohm load across the output. The voltage should drop less than 1V. If these test are OK, then U9, or R93-R98 are at fault. Repair as necessary and go to the functional test, Paragraph 5.1.2.1.
7. The problem is in the buffer amplifier. If the load regulator is poor, suspect Q8-Q10. Repair as necessary and go to the functional test (Paragraph 5.1.2.1.).

5.1.2.1 Excitation Power Supply Functional Test

Connect the unit per figure 5.1 and set the excitation supply for constant voltage operation and adjust the supply for 15V output or 30V output for the 30V excitation option.

1. Connect a 150 ohm load or a 300 ohm load for the 30V excitation option across the excitation supply. Connect both the sense and power lines to the load.
2. With the unit set to constant voltage excitation, adjust the EXC pot through its range. Verify the excitation output is adjustable from -.2V to 0.1V to 15 to 16.5V. (30 to 33V for the 30V excitation option.)
3. With the EXC pot fully clockwise set the EXC switch to the OFF position. Verify the voltage across the load resistor is less than 100 uV and the collector of Q10 is -.4 to -0.9V referenced to triangle Bo.
4. Turn the EXC switch ON and set the unit for constant current operation and LCL sense. Adjust the EXC pot throughout its range. Verify the excitation output is adjustable from -0.05V - 0.05V to 15V - 18.2V. (25 to 36.4V for the 30V excitation option.)
5. With the EXC pot fully clockwise set the EXC switch to the OFF position. Verify voltage across the load resistor is less than 100 uV and the collector of Q10 is -.4V to -0.9V referenced to triangle Bo.

5.1.3 Auto Zero Board

The Auto Zero Board contains both analog and digital circuitry and is difficult to troubleshoot. Set the AUTO ZERO switch to the OFF position and the excitation to 10V. Connect a simulated 350 ohm full bridge to the instrument. Set the gain to 100. Install a bridge completion board set up for auto balance or test board (Part number 086625). For this section low means 0-.2V and high means +15±1V.

1. Measure the +15V and -15V power supplies. They should be +15±1V and -15±1V respectively. If not, repair the power supply as required. ICs may be removed from their sockets to remove the load from the supply. Do not interchange ICs. All ICs must be returned to their original socket unless defective, it should then be replaced. Check the following measurements.
2. Check the following measurements.

MEASUREMENT POINT	REQUIREMENTS	GO TO STEP IF NOT WITHIN REQUIREMENTS
Pin 1, U5 (+Ref)	+3.0 to +3.6V	Step 3
Pin 7, U5 (-Ref)	-3.0 to -3.6V	Step 4
Pin 1, U12	0 ± 0.02V	Step 5
Pin 7, U12	1/2 of +REF voltage ±0.02V	Step 7
Pin 1, U15	0V ±0.05V	Step 9
All OK		Step 10

3. Check the reference instrumentation amplifier. Replace U3 and/or U5. If that doesn't correct the problem check resistors R7-R11 or R19 and R20 or possible loading from the front panel BAL control or U16 or U17. Go back to Step 2.
4. The problem can only be U5, or R23, R24, or R21, or possible loading from the BAL control.
5. Measure the outputs U6 and U7, pins 1-4 and 12-15, they should all be low. If not go to Step 18.
6. The problem is either U16 or U12. Repair as required, return to Step 2.
7. Measure the outputs U18 and U7. Pins 1, 2, 3 of U18 should be low and pin 4 of U18 high. Pins 1-4 and 12-15 of U7 should be low. If not go to Step 18.
8. The problem is U17 or U12. Repair as required and go back to Step 2.
9. Adjust R38 so that pin 2 of U15 is at 0V. Remeasure pin 1, U15 and if not within ±50 mV, then the problem is U15 or R26, R28, R29 or the zero control R38. Repair as required and continue this sequence.
10. Set the AUTO ZERO switch to the OFF position. Set the gain to 100. Adjust the front panel BAL to set the tape output of the amplifier to +0.1 ±0.01V.
11. Place the AUTO ZERO switch to the ON position. The front panel ACTIVE lamp should come on for 8 ± 2 seconds and then go off. The tape output should be at 0 ± 10 mV. If so go to the System Zero Procedure, Paragraph 5.2 followed by the auto zero functional test, Paragraph 5.1.3.1.
12. If the lamp did not come on or stayed on or was on for the wrong length of time, go to Step 19. Otherwise continue this procedure.
13. Measure the +16V power supply, pin 7 of U1 with reference to square Bo. It should be +16 ±1V. If its out of tolerance, then repair the amplifier power supply as required. Also check to see if the auto zero board is properly installed in the unit i.e. all pins are in their respected sockets. Repeat by measuring the -16 ±1V power supply, pin 4 of U1.

14. Measure the output of U1, pin 6. Vary the BAL control so the tape output changes from plus to minus. Pin 6 of U1 should be minus when the tape output is plus and plus when the tape output is minus. If this is not the case replace U1 and try again. Problems could be with the passive elements around U1 or Q1 or Q2. Repair as required.
15. Set the unit to a gain of 1 and use the BAL control to set the tape output to 0V ±0.5mV. Adjust R2 so that pin 6 of U1 is at 0V ±1V. Repeat step 11 before continuing this procedure.
16. Measure pin 3 of U8. It should be low when the tape output is minus and high when the tape output is plus. This measurement can only be performed while the ACTIVE lamp is illuminated, therefore toggle the AUTO ZERO switch from ON to OFF to ON to make this measurement.
17. If pin 3 of U8 fails to go high, check pin 12 of U8, it should be high while the ACTIVE lamp is illuminated. If not replace U8. If pin 3 of U8 is high then replace U2. Repair as required and go to Step 10.
18. The problem may be in the SAR or the DAC. Replace U6, U7, U18, U16 and U17. Use substitution method to find the bad part. Repair as required, go to Step 10.
19. The problem is in the digital section. The most effective way to troubleshoot the digital section is to remove the State counter U19 and replace it with a fixture as shown in figure 5.2. This fixture allows one to statically select any state and make static circuit measurements. Turn the ac power off, remove U9 and install the test fixture in place of U9.
20. Clock Test. Set the fixture to State 0. The clock U21 should be free running and the ACTIVE lamp should be on. The clock frequencies are shown below. If they are not operating correctly, change U21. Also look for loading effects from other circuit elements. If the ACTIVE lamp is not illuminated, measure pin 3 of U9, it should be low. If it's not replace U9 and if it is low replace DS5.

U21 PIN #	EXPECTED FREQUENCY	EXPECTED PERIOD
9	571 - 1000 Hz	1.00 - 1.75 mS
5	17.8 - 31.2 Hz	32 - 56mS
14	2.23 - 3.91 Hz	256 - 448 mS
3	.061 - .035 Hz	16.3 - 28.7mS

21. Reset control logic check. The output of the reset control logic is pin 10 of U9 and all references to reset output in this section means measure pin 10 of U9. The output is a pulse about 100 ms wide except for a remote auto zero input, the output in this case is steady state with the same duration as the remote reset.

NOTE

The description in parenthesis describes the logic path being tested and Table 5.1 describes the logic condition for each test step.

21.1 Set the fixture to state 0, AUTO ZERO to ON and no remote auto zero. Turn the ac power off. Measure pin 8 of U8 and reapply the ac power. Pin 8 of U8 should go high for 0.4 to 0.6 seconds and the reset output should give a pulse. (U8-8, U9-6, U9-4, U10-11, U20-4).

21.2 Set the fixture to state 3 and AUTO ZERO switch to OFF. Cycle the ac power a reset output should be produced. (U9-5, U9-6, U9-4, U10-12, U10-13, U10-11, U20-4).

21.3 Set the fixture to state 3 and toggle the AUTO ZERO switch OFF to ON to OFF. This should produce a reset output. (U10-13, U9-5, U9-4, U10-12, U10-11, U20-4).

21.4 Set the fixture to state 3 and AUTO ZERO switch to ON. Cycle the ac power and verify there is no reset output. (U8-11, U8-10, U10-5, U10-4, U10-2, U10-3, U20-3, U10-6, U10-1).

21.5 Set the fixture to state 2. With the AUTO ZERO switch ON apply a remote auto zero command. This should produce a reset output. Turn the AUTO ZERO switch to OFF and apply a remote auto zero command, no reset output should be generated. (U11-2, U11-1, U11-3, U9-9).

22. Next State Logic.

22.1 Set the fixture to state 0. The clock should be running and the ACTIVE lamp should be illuminated. The next state output (U9, pin 11) should be high when EOCA is low and low when EOCA is high. (U8-5, U8-6, U11-8, U11-9, U11-10, U9-13, U9-11).

22.2 Set the fixture to state 1. The next state output should be low at all times. (None).

22.3 Set the fixture to state 2 and the AUTO ZERO switch to ON position. The next state output should be low at all times. (None).

22.4 Set the fixture to state 3. The next state output should be high at all times. (U9-12, U9-11).

See Table 5.2 for the logic conditions.

23. Clock Control Logic

23.1 Set the fixture to state 0. The clock should be operating and the ACTIVE lamp illunimated. (None).

23.2 Set the fixture to state 2 and the AUTO ZERO switch to ON The clock should be operating and the ACTIVE lamp illuminated. (U11-12, U11-13, U11-11, U20-9, U20-13).

23.3 Set the AUTO ZERO switch to OFF. The clock should not be running and the ACTIVE lamp should not be illuminated. (U11-12, U11-13, U11-11, U20-9, U20-13).

23.4 Set the fixture to state 3. The ACTIVE lamp should be illuminated when EOC is low and not illuminated when EOC is high. (U11-6, U11-5, U11-4, U20-10, U20-13).

23.5 Set the fixture to state 1. The ACTIVE lamp should be illuminated. Energize the remote auto zero circuit, the ACTIVE lamp should not be illuminated while the remote auto zero circuit is energized. (U20-12, U20-13).

23.6 Set the fixture to state 1. Cycle the ac power. The ACTIVE lamp should not be illuminated until the PU signal returns to 0, approximately .5 seconds after power is reapplied to the unit. (U20-11, U20-13).

See Table 5.3 for the logic conditions for the above test.

NEXT STATE CONTROL LOGIC TABLE, 5.2

STEP	STATE	AUTO ZERO SWITCH	U8 5	U8 6	U11 9	U11 10	U11 12	NEXT STATE OUTPUT U11 - 11
22.1	{0}	X	0	1	1	1	0	1
22.1	{0}	X	1	0	1	0	0	0
22.2	{1}	X	X	X	0	0	0	0
22.3	{2}	ON	X	X	0	0	0	0
22.4	{3}	X	X	X	0	0	1	1

X = Don't Care

CLOCK CONTROL LOGIC, TABLE 5.3

STEP	STATE	AUTO ZERO SW	REMOTE AUTO ZERO	PWR UP	U 11 12	U 11 13	U 11 11	U 11 6	U 11 5	U 11 4	U 20 11	U 20 12	CLK RST OUT U20 - 13
23.1	{0}	ON	NO	NO	0	0	0	0	X	0	0	0	0
23.2	{2}	ON	NO	NO	1	0	0	0	X	0	0	0	0
23.3	{2}	OFF	NO	NO	1	1	1	0	X	0	0	0	1
23.4	{3}	OFF	NO	NO	0	1	0	1	0	0	0	0	0
	{3}	OFF	NO	NO	0	1	0	1	1	1	0	0	1
23.5	{1}	OFF	NO	NO	0	1	0	0	X	0	0	0	0
	{1}	OFF	YES	NO	0	1	0	0	X	0	0	1	1
23.6	{1}	OFF	NO	YES	0	1	0	0	X	0	1*	0	1

*During power up only, returns to 0 1/2S after power is applied.

X = Don't Care

RESET LOGIC ~~TABLE~~ TABLE 5.4

STEP	STATE	AUTO ZERO SW	PWR UP	RE-MOTE AUTO ZERO CMD	U11-- 1	2	3	U10---------- 8	9	10	11	12	13	4	5	6	U10 1	3	U9-- 10	8	U20 1
21.1	{0}	ON	YES	NO	1	0	0	0	0	0	0	1	0	1	1	1	1	1	P	P	P
PU is high.																					
21.2	{3}	OFF	YES	NO	0	0	0	0	1	0	1	1	1	0	0	1	0	0	P	P	P
PU is high.																					
21.3	{3}	OFF	NO	NO	0	0	0	0	1	0	1	1	1	0	0	0	0	0	P	P	P
21.4	{3}	ON	NO	NO	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0
21.5	{2}	ON	NO	YES	1	1	1	0	0	0	0	0	0	0	1	0	1	0	1	0	1
21.5	{2}	OFF	NO	YES	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

1 = 15V
0 = 0V
P = 100 ms pulse zero positive going.
PU can be made high by shorting C9.

24. Repair the digital section as required and replace the test fixture with the IC removed from U19. If the auto zero function still doesn't operate, replace U19. Go to step 10.

5.1.3.1 Auto Zero Functional Test

Shunt an appropriate bridge arm to produce bridge offset voltages as shown below and for each offset voltage perform an auto zero function. For each step the tape output should return to 0V ±0.02V. A complete system zero may have to be performed in order to have the tape output return to 0 within 500 uV. See section 5.2 for the system zero. See section 4 for calculation of resistor values.

REQUIRED OFFSET

+ 14.5 mV/V
+ 10 mV/V
+ 5 mV/V
+ 2.5 mV/V
0 mV/V
- 2.5 mV/V
- 5 mV/V
- 10 mV/V
- 14.5 mV/V

5.2 System Zero Procedure

The purpose of this procedure is to adjust all the various internal and front panel zero adjustments.

1. If auto zero is present, set the AUTO ZERO switch to the OFF position and set the BAL control to the center of its mechanical range.
2. Short the amplifier input i.e., tie P2, 1, 2 and 6 together however leave the 1 kohm resistors and switches in the circuit as they will be used later. See Figure 5.1.
3. Set the gain switch to 1000 and the CAL switch to the CAL position.
4. Monitor the tape output on a DVM or equivalent.
5. Open and close the switch (S2) which shorts the resistor in series with the + amplifier input. Adjust the + input bias current pot (R53) so that the change in output voltage while the switch (S3) is changed from open to close is less than 1mV at the tape output.
6. Repeat Step 5 for the - amplifier input using switch S1 and adjusting the - input bias pot (R54).
7. Place the INPUT DISC switch in the DISC position.
8. Set the GAIN switch to 1 and adjust the tape zero until the tape output is at 0 $\pm$ 1mV.
9. Set the GAIN switch to 1000 and adjust the RTI pot to the center of its electrical range. If the offset is more than $\pm$ 35 mV at the tape output, then a coarse RTI zero adjustment will be required. If the offset is less than $\pm$ 35 mV go to Step 11.
10. Coarse RTI zero adjustment. Remove any resistor installed in R60 and/or R64 and measure the offset at the tape output. Install one of the following resistors. If the tape output is positive install R60 and if the tape output is negative install R64. The required value is listed in Table 5.4. If the offset at the tape output is greater than $\pm$500 mV, then the circuit must be repaired and the zero procedure will have to be repeated. Components which can cause zero error are Q1, U5, R61 and R65.

OFFSET	RESISTOR VALUE
25 mV	9.31K
50 mV	4.32K
75 mV	2.74K
100 mV	1.96K
125 mV	1.43K
150 mV	1.1K
175 mV	909
200 mV	732
225 mV	604
250 mV	499
275 mV	402
300 mV	324
325 mV	267
350 mV	215
375 mV	165
400 mV	124
425 mV	82.5
450 mV	53.6
475 mV	24.9
500 mV	Short

Table 5.5 RTI Zero Trim Values

11. Adjust RTI pot so the output is 0V ± 1mV.
12. Repeat steps 8 and 11 until the output is 0 ± 1mV for all gain steps.
13. Set the GAIN switch to 1.
14. Set the VAR GAIN control fully clockwise.
15. Move the CAL switch from the CAL position to the VAR position and adjust var gain zero (R26) until the change in output offset is less than 1mV as the CAL switch is opened and closed.
16. Readjust the tape zero.
17. Connect a remote dummy 350 ohm bridge and set the excitation to produce 10V across the bridge. Set the INPUT DISC switch to the connect position and the GAIN switch to 1. Use the Bal control to precisely set the tape output to 0V ± 0.1mV. Adjust the bal zero (R25) so that the front panel BAL LED is off (neither red or green).
18. If the auto zero assembly is present, then perform steps 19 and 20, otherwise go to Step 21.
19. Adjust the tape output zero per Step 17. Adjust R2 located on the auto zero board so that pin 6 of U1 (located on the auto zero board is at 0±0.5V with reference to square Bo.

20. With the external bridge connected, set the unit to a gain of 1000. With the AUTO ZERO switch in the off position, adjust the BAL pot to set the tape output to 0 ± 5mV. Turn the excitation off by setting the EXC switch to the off position. Adjust R32 located on the auto zero board so the tape output is at 0 ± 5mV. Turn the excitation on and re-adjust the BAL control so the tape output is a 0 ± 5mV. The tape output should not change by more than 5mV as the excitation switch is tuned from off to on to off. If the change is greater than 5mV readjust R32. Readjust the tape output to 0±1mV using the BAL control with the excitation on.
21. If the galvo output is present, adjust the GALVO ZERO so that the galvo output is at 0±3mV.

5.3 Common-Mode Rejection Adjustment

1. Connect the unit per Figure 5.2 and apply ac power.
2. Apply 100V p-p 60 Hz Common-mode signal to the unit.
3. Set the unit to gain 1 and adjust the CMR pot R29 so the tape output contains a minimum 60 Hz component. Should be less than 20 mV p-p.
4. Set the GAIN switch to 1000 and the CAL switch to the CAL position.
5. The tape output should be less than 100 mV p-p.

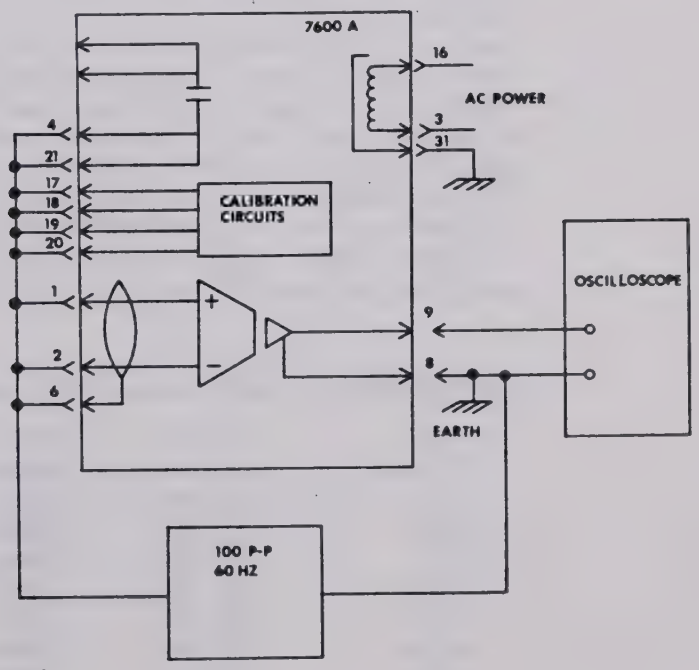


Fig. 5-2 Common Mode Adjustment

5.4 Gain Accuracy Adjustment

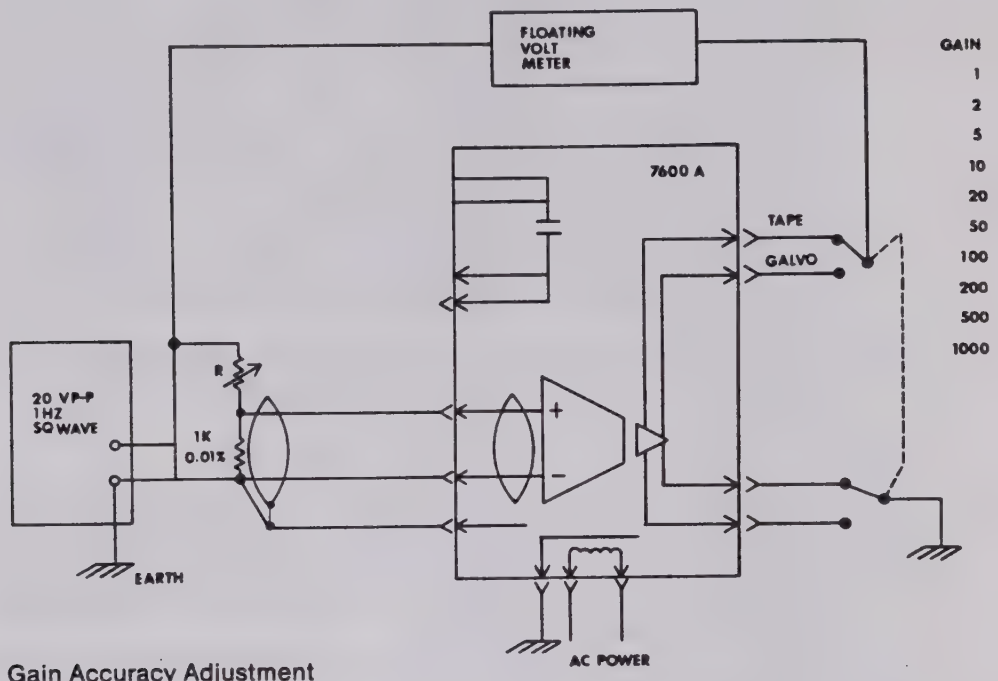


Fig. 5-3 Gain Accuracy Adjustment

1. Connect the equipment per Figure 5.3 and select R1 to provide correct alternation for the gain step being measured.
2. Set the GAIN switch to 1, CAL switch to the CAL position and measure the gain with reference to the tape output.
3. Measure the gain accuracy on gain 1. Adjust the gain trim pot R28 for a gain error of less than 0.01%. If R28 should have insufficient range, then set R28 to the center of its range and measure gain error and remove any resistor installed for R11 and/or R14. Select and install R11 and R14 per Table 5.5. R11 is installed when the gain is low and R14 is installed when the gain is high.

GAIN ERROR	R11	R14
1%	124K	499K
1.5%	82.5K	340K
2%	61.9K	255K
2.5%	49.9K	200K
3%	41.2K	174K
3.5%	35.7K	147K
4%	30.9K	127K
4.5%	27.4K	115K
5%	24.9K	100K
5.5%	22.1K	93.1K
6.0%	20.5K	84.5K

TABLE 5.6 TRIM VALUES

4. If the galvo output is installed, then measure the galvo output and adjust R201 located on the galvo assembly for less than 0.01% gain error.
5. Measure the gain accuracy for all other positions on the gain switch.
6. Measure the range of the variable gain control.
7. If the gain trim pot (R28) on the CMR trim pot (R29) is readjusted for any reason, then Steps 1-5 of this section will have to be repeated.

DRAWING LIST
FOR
7600A
ASSEMBLY NUMBER
400171-000 thru 400171-383

LM'S AND ASSEMBLIES

400171	Family Tree
400171*	Top Assembly
086519*	System Assembly
086520*	Main PCB Assembly
086574*	Galvo Output Assembly
087268-001*	Bridge Completion - T Balance Assembly
087268-002*	Bridge Completion - Voltage Insertion Assemb
087268-003*	Bridge Completion - Auto Zero Assembly
086551*	Auto Zero Assembly
086551-001*	Auto Zero Assembly With Battery Backup
086551-002*	Voltage Insertion Balance Assembly

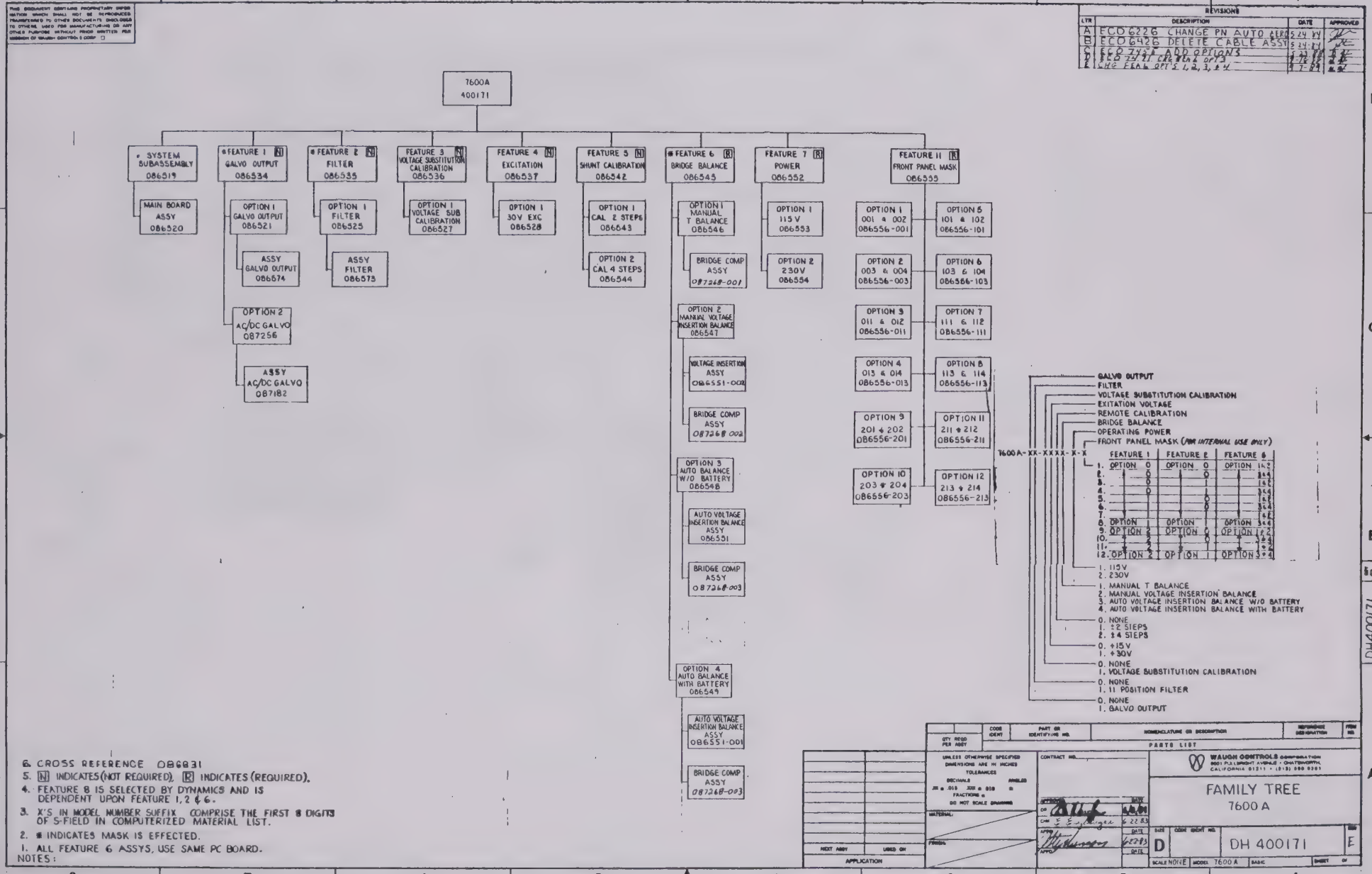
SCHEMATICS

086617	Galvo Assembly
086614	Filter Assembly
086620	Bridge Completion Assembly
086629	Voltage Insertion Assembly
086622	Auto Zero Assembly
086621	Top Assembly

OTHER DRAWINGS

7914AR/VX-2	
086668	Schematic
400172*	Top Assembly Material List
086660*	Mating Connectors

* Includes List of Materials


7600A
400171
SYSTEM SUBASSEMBLY 086519
MAIN BOARD ASSY 086520
FEATURE 1 N GALVO OUTPUT 086534
OPTION 1 GALVO OUTPUT 086521
ASSY GALVO OUTPUT 086674
OPTION 2 AC/DC GALVO 087256
ASSY AC/DC GALVO 087182
FEATURE 2 N FILTER 086535
OPTION 1 FILTER 086525
ASSY FILTER 086573
FEATURE 3 N VOLTAGE SUBSTITUTION CALIBRATION 086536
OPTION 1 VOLTAGE SUB CALIBRATION 086527
FEATURE 4 N EXCITATION 086537
OPTION 1 30V EXC 086528
FEATURE 5 N SHUNT CALIBRATION 086542
OPTION 1 CAL 2 STEPS 086543
OPTION 2 CAL 4 STEPS 086544
FEATURE 6 R BRIDGE BALANCE 086545
OPTION 1 MANUAL T BALANCE 086546
BRIDGE COMP ASSY 087268-001
OPTION 2 MANUAL VOLTAGE INSERTION BALANCE 086547
VOLTAGE INSERTION ASSY 086551-002
BRIDGE COMP ASSY 087268-002
OPTION 3 AUTO BALANCE W/O BATTERY 086548
AUTO VOLTAGE INSERTION BALANCE ASSY 086551
BRIDGE COMP ASSY 087268-003
OPTION 4 AUTO BALANCE WITH BATTERY 086549
AUTO VOLTAGE INSERTION BALANCE ASSY 086551-001
BRIDGE COMP ASSY 087268-003
FEATURE 7 R POWER 086552
OPTION 1 115 V 086553
OPTION 2 230V 086554
FEATURE 11 R FRONT PANEL MASK 086555
OPTION 1 001 & 002 086556-001
OPTION 2 003 & 004 086556-003
OPTION 3 011 & 012 086556-011
OPTION 4 013 & 014 086556-013
OPTION 5 101 & 102 086556-101
OPTION 6 103 & 104 086556-103
OPTION 7 111 & 112 086556-111
OPTION 8 113 & 114 086556-113
OPTION 9 201 & 202 086556-201
OPTION 10 203 & 204 086556-203
OPTION 11 211 & 212 086556-211
OPTION 12 213 & 214 086556-213
7600A-XX-XXXX-X-X
GALVO OUTPUT
FILTER
VOLTAGE SUBSTITUTION CALIBRATION
EXITATION VOLTAGE
REMOTE CALIBRATION
BRIDGE BALANCE
OPERATING POWER
FRONT PANEL MASK (FOR INTERNAL USE ONLY)
FEATURE 1 FEATURE 2 FEATURE 6
1. OPTION 0 OPTION 0 OPTION 1&2
2. 0 0 3&4
3. 0 0 1&2
4. 0 0 3&4
5. 0 1 1&2
6. 0 1 3&4
7. 1&2
8. OPTION OPTION OPTION 3&4
9. OPTION OPTION OPTION 1&2
10. 3&4
11. 1&2
12. OPTION OPTION OPTION 3&4
1. 115V
2. 230V
1. MANUAL T BALANCE
2. MANUAL VOLTAGE INSERTION BALANCE
3. AUTO VOLTAGE INSERTION BALANCE W/O BATTERY
4. AUTO VOLTAGE INSERTION BALANCE WITH BATTERY
0. NONE
1. ±2 STEPS
2. ±4 STEPS
0. +15V
1. +30V
0. NONE
1. VOLTAGE SUBSTITUTION CALIBRATION
0. NONE
1. 11 POSITION FILTER
0. NONE
1. GALVO OUTPUT

LTR	DESCRIPTION	DATE	APPROVED
A	ECO 6226 CHANGE PN AUTO CAL	5-24-84	
B	ECO 6426 DELETE CABLE ASSY	5-24-84	
C	ECO 7457 ADD OPTIONS	1-21-85	
D	ECO 7497 CHG VOLT OPTS	4-24-85	
E	CHG FEAT OPTS 1, 2, 3, & 4	9-1-89	

NOTES:
1. ALL FEATURE 6 ASSYS, USE SAME PC BOARD.
2. * INDICATES MASK IS EFFECTED.
3. X'S IN MODEL NUMBER SUFFIX COMPRISE THE FIRST 8 DIGITS OF S-FIELD IN COMPUTERIZED MATERIAL LIST.
4. FEATURE 8 IS SELECTED BY DYNAMICS AND IS DEPENDENT UPON FEATURE 1, 2 & 6.
5. N INDICATES (NOT REQUIRED), R INDICATES (REQUIRED).
6. CROSS REFERENCE 086831

PARTS LIST

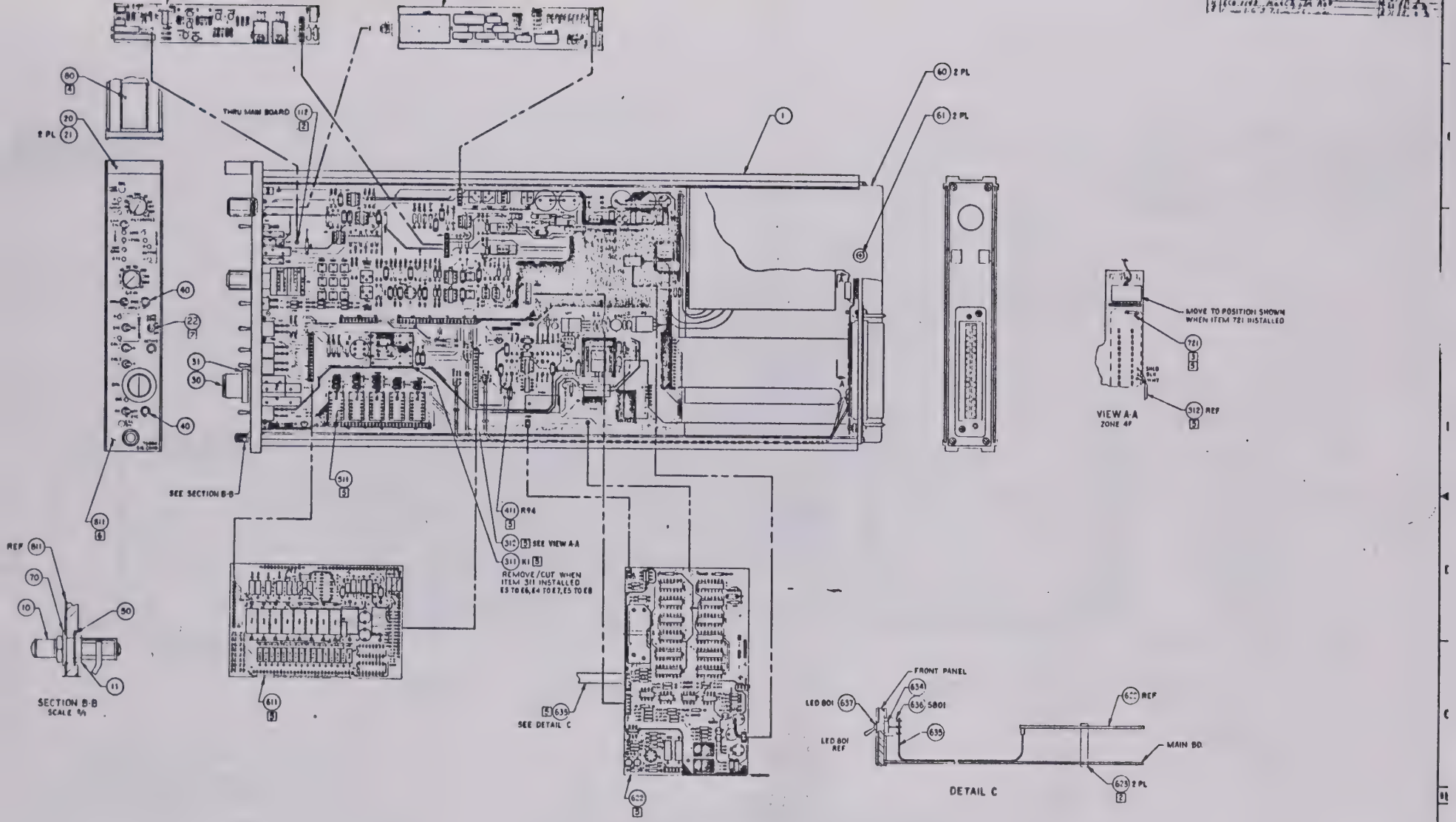
WAUGH CONTROLS CORPORATION
9001 PLEASANT AVENUE • CHATSWORTH, CALIFORNIA 91311 • (213) 998 0201

FAMILY TREE
7600 A

SIZE D | CODE IDENT NO. | DH 400171 | REV E

SCALE NONE | MODEL 7600 A | BASIC | SHEET OF

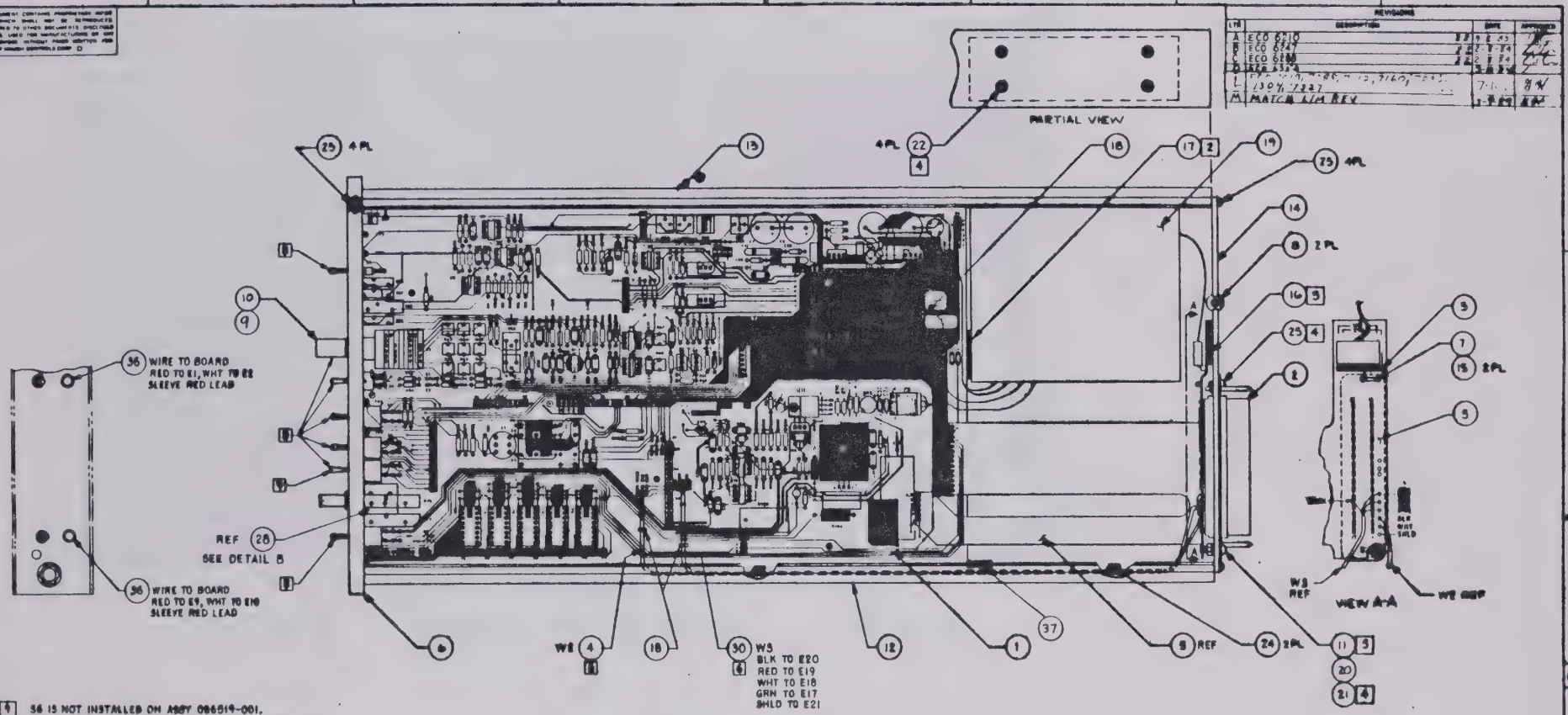
DH400171



LUG SCES ON THE SWITCH (S801), A WIRE IS ATTACHED FROM THE ... S TO E40 ON THE M/B.
LEGENDS SHOWN ARE FOR REFERENCE ONLY-DIFFERENT SYSTEMS MAY HAVE DIFFERENT LEGENDS.
COMPONENT IS AN OPTION AND MAY NOT BE REQUIRED.
METAL STAMP, TYPE OR ETCH ON ITEM 80, MODEL NO., PART NO. 400171 & APPROPRIATE DASH NO. LATEST REV LETTER, SERIAL NO. AND DATE OF MFG. LOCATE ON UNIT AFFROX AS SHOWN
REMOVE EXISTING FUSE AND RETURN TO STOCK UNDER PART NO. 235107 WHEN ITEM 721 IS TO BE INSTALLED.
APPLY LOCTITE ITEM 85 TO ITEMS 112 & 623 AFTER ASSEMBLY.
FOR MATERIAL LIST SEE CROSS REF LIST CR6851 TO DETERMINE APPROPRIATE COMPUTER S-NO.
OTES:

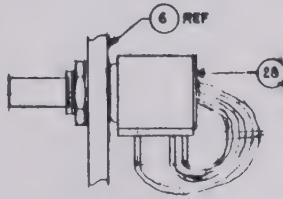
ASSEMBLY, MODEL 7600A

E 400171


PARTIAL VIEW
VIEW A-A
WIRE TO BOARD RED TO E1, WHT TO E2 SLEEVE RED LEAD
WIRE TO BOARD RED TO E9, WHT TO E10 SLEEVE RED LEAD
REF SEE DETAIL B
W3 BLK TO E20 RED TO E19 WHT TO E18 GRN TO E17 SHLD TO E21
W2 REF
W3 REF

4. S6 IS NOT INSTALLED ON ASSY 086519-001.
8. ALIGN SWITCHES, S1 THRU S7, IN FRONT PANEL, ITEM 6, PRIOR TO SOLDERING IN BOARD.
7. IDENTIFY BY TAGGING WITH PART NO. 086819, DASH NO., AS APPLICABLE, AND LATEST REV. LETTER.
6. TWIST CABLES W2 (ITEM 4) AND W3 (ITEM 30) TOGETHER, APPROX 1 TWIST PER INCH.
5. BEND ITEM 11 (LUG) TO ACCOMMODATE HOLE IN FLEX CABLE.
4. APPLY ITEM 26 (LOCTITE) TO THREADS BEFORE INSTALLATION.
3. PLACE EXPOSED ADHESIVE SIDE OF ITEM 16 TO FLEX CABLE AS SHOWN. AFTER FLEX CABLE IS INSTALLED ON THE CONNECTOR, ITEM 2, THEN PEEL BACKING FROM TAPE AND PLACE ON REAR PANEL, CENTRALIZE AND LOCATE APPROX AS SHOWN.
2. PLACE ADHESIVE SIDE OF ITEM 17 TO TRANSFORMER, CENTRALIZE AND LOCATE APPROX AS SHOWN.
1. FOR MATERIAL LIST SEE TABULATION.

NOTES:



DETAIL B
FASTEN R76 TO PANEL (ITEM 6) BEFORE SOLDERING TO BOARD

086819-001	AL086819-001
086519	AL086519
ASSY NO.	MATL LIST

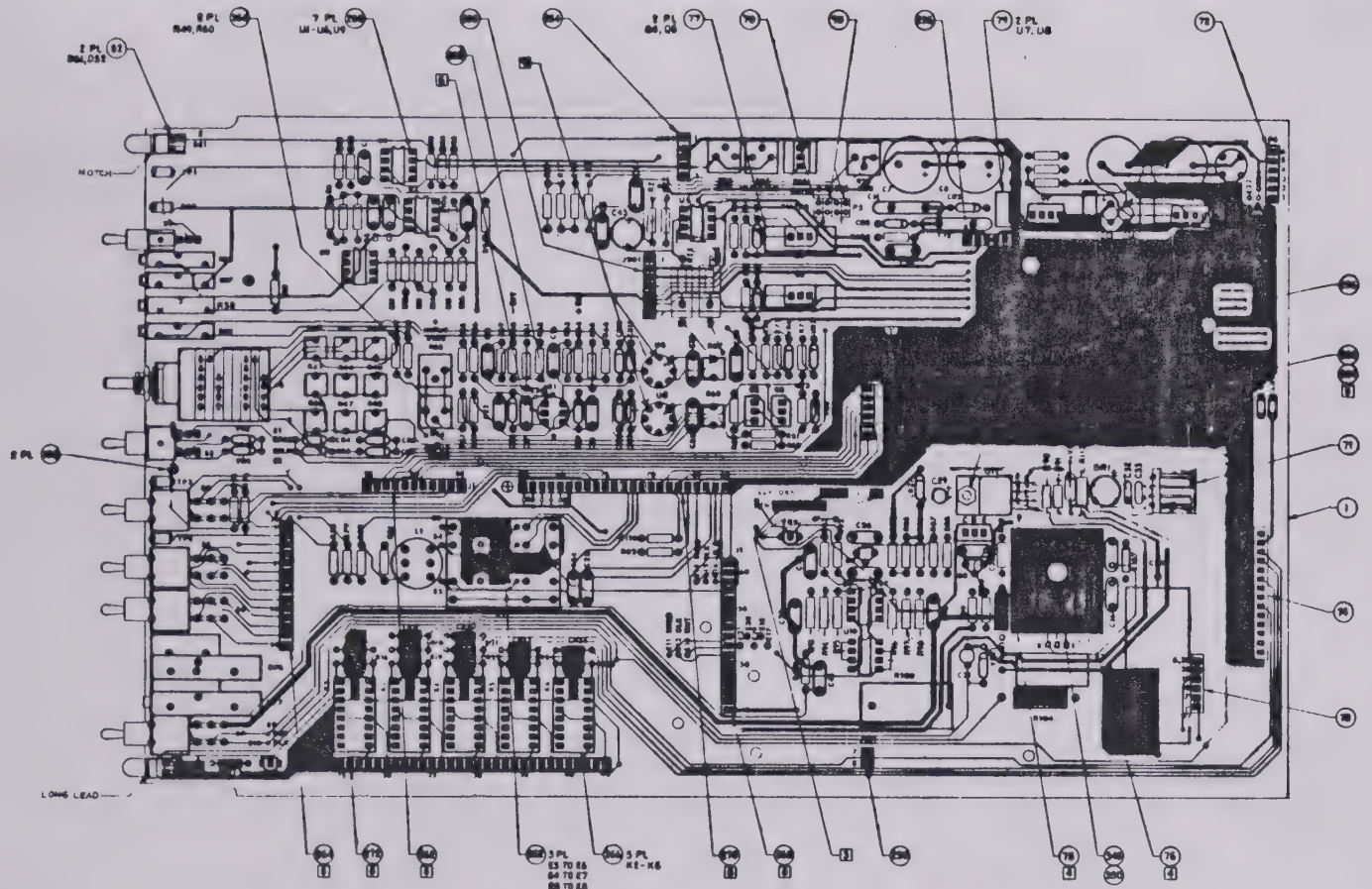
TABULATION

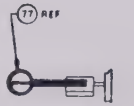
LTR	DESCRIPTION	DATE	APPROVED
A	ECO 6210		
B	ECO 6247		
C	ECO 6348		
D	ECO 6374		
L	ECO 7227	7-1-	
M	MATCH A/M REV		

SYSTEM ASSEMBLY 7600 A BASIC

D P-086519

P-086519





PARTIAL VIEW

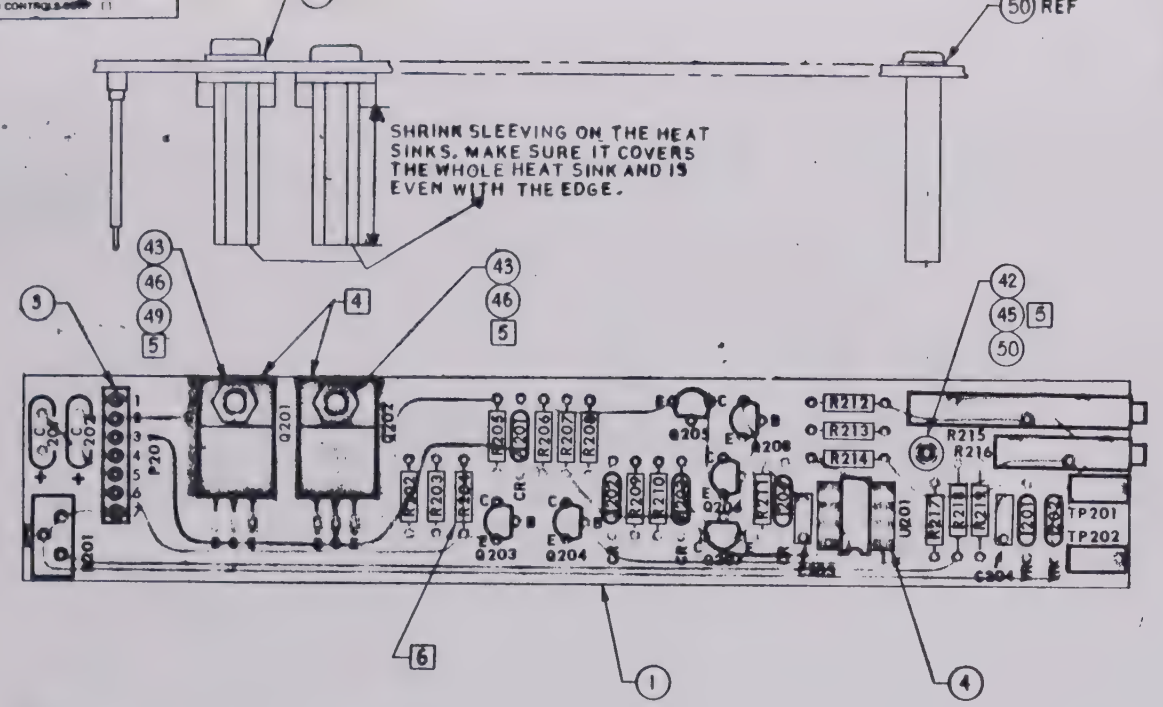
PARTIAL VIEW

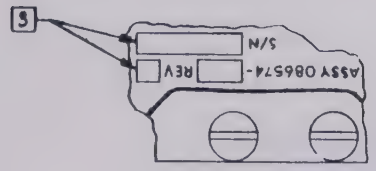
2. CUT LEADS OF U6 & U8 SO THAT IC'S MOUNT FLUSH TO SOCKETS
3. USE FIXTURE 086532-999 TO ALIGN SOCKETS ITEMS 268,266,270 & 272 BEFORE SOLDERING.
4. COMPONENTS SHOWN FOR REF ONLY NOT INSTALLED AT THIS LEVEL: K1-K6, U10, R58, R76, R94, R96, R97, C84-C87, S1 THRU S7, W10, W12
5. Q1 CANNOT BE FLOW SOLDERED. IT MUST BE HAND SOLDERED AFTER FLOW SOLDERING BOARD.
6. APPLY ITEM 344 (LOCTITE) TO THREADS AFTER ASSEMBLY.
7. APPLY ITEM 340 (THERMAL COMPOUND) BETWEEN ITEM 70 & 76 AND BETWEEN ITEM 70 & 80 BEFORE ASSEMBLY.
8. MARK BOARD WITH LATEST REVISION LETTER, SERIAL NO. AND MODEL NAME OR NO., IF APPLICABLE, IN LOCATION SHOWN. METAL STAMP OR PERMANENT INK.
9. RESISTOR SOLDER ON LEAD EXTENDING ON OPPOSITE SIDE OF BOARD IS OK.
10. REF DES'S: 086532-0 , SCHEMATIC 086621 PUBLICATION 086613 , DRAWING 086616

			ASSEMBLY, MAIN P.C. BOARD, 7600A
			E 086520 P

086520 REV

REV	DESCRIPTION	BY	DATE	APPD
A	ECO 6293 ADDED ITEM 49	WE	2/9/84	
B	ECO 6568 ADDED ITEM 50	WE	2/11/84	
C	ECO 7136 MATCH L/M REV	WE	6/11/87	
D	ECO 7348 MATCH L/M REV	WE	4/27/87	
E	ECO 7481	WE	9/28/88	





6 PART SHOWN FOR REFERENCE ONLY NOT INSTALLED AT THIS LEVEL. (R204)

5 APPLY ITEM 48 (LOCTITE) TO ITEMS 45 & 46 AFTER ASSEMBLY.

4 APPLY ITEM 47 (THERMAL COMPOUND) BETWEEN Q201, Q202 AND ITEM 1 BEFORE ASSEMBLY.

3. METAL STAMP OR VIBRO-ETCH LATEST REVISION LETTER, SERIAL NO. AND ASSY DASH NO., AS APPLICABLE, IN LOCATION SHOWN.

2. MAXIMUM SOLDER OR LEAD EXTENSION ON OPPOSITE SIDE OF OF BOARD IS .03.

1. REF DWG'S: MATL LIST AL086574, SCHEMATIC 086617, FABRICATION 086588, ARTWORK 086587.

NOTES:

QTY REQD PER ASSY	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	REFERENCE DESIGNATION	ITEM NO.

PARTS LIST

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS .XX ± .010 .XXX ± .010
ANGLES ±
FRACTIONS ±
DO NOT SCALE DRAWING

MATERIAL:

FINISH:

CONTRACT NO.

	APPROVED	DATE
DR	R. VANDERPOOL	7-6-89
CHK	E. Engberger	7-12-89
APPD		7-11-89
APPD		DATE

WAUGH CONTROLS CORPORATION
8001 FULLBRIGHT AVENUE • CHATSWORTH, CALIFORNIA 91311 • (213) 998 8281

ASSEMBLY, GALVO OUTPUT

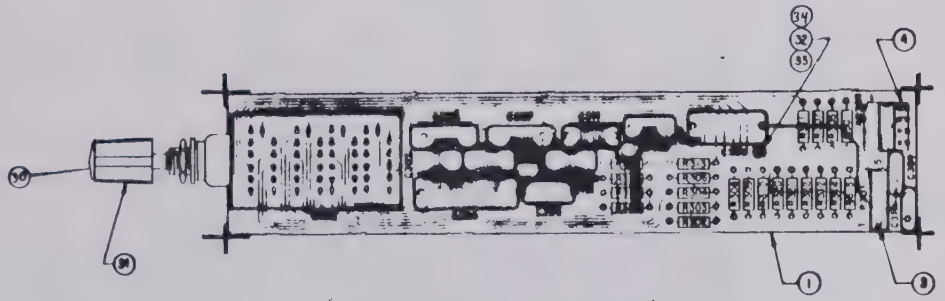
SIZE	CODE IDENT NO.		REV
C		086574	F

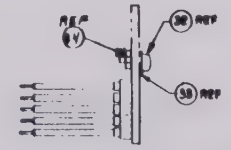
SCALE 2/1 | MODEL | BASIC | SHEET 1 OF 1

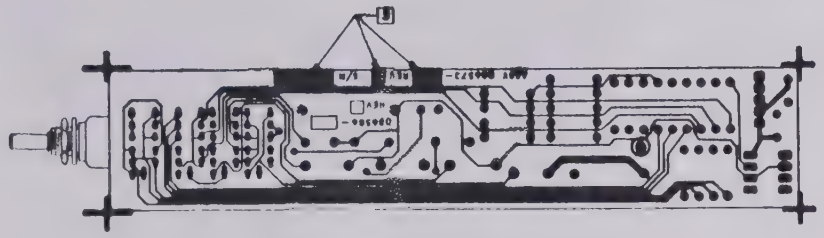
086574

4 3 2 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	INITIAL RELEASE	8-10-83	
B	ECO 6248	8-23-83	
C	ECO 6298	9-29-83	
D	[illegible]	[illegible]	
E	ECO 6414	2-14-84	
F	ECO 7161 ADD 5 VOLT TEST POINT	4-27-87	
G	ADD KNOB CAP ITEM 30	1-27-88	







TABULATION

ASSY No.	MATERIAL LIST No.
086573	086573
086573-001	086573-001
086573-002	086573-002
086573-003	086573-003

4. ALL PARTS ARE SHOWN. INSTALL ONLY THOSE PARTS SHOWN ON MAT'L LIST.
5. MARK BOARD WITH LATEST REVISION LETTER, SERIAL NO. AND ASSY. DASH NO., IF APPLICABLE. NO LOCATION SHOWN. METAL STAMP OR VIBRO-ETCH.
6. MAXIMUM SOLDER OR LEAD EXTENSION ON OPPOSITE SIDE OF OF BOARD IS .03.
7. REF DWG'S: MATL LIST AL086573 , SCHEMATIC 05 086414 FABRICATION CF 086686 , ARTWORK CY 084588.

NOTES:

QTY REQD PER ASSY	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION			
		PARTS LIST			

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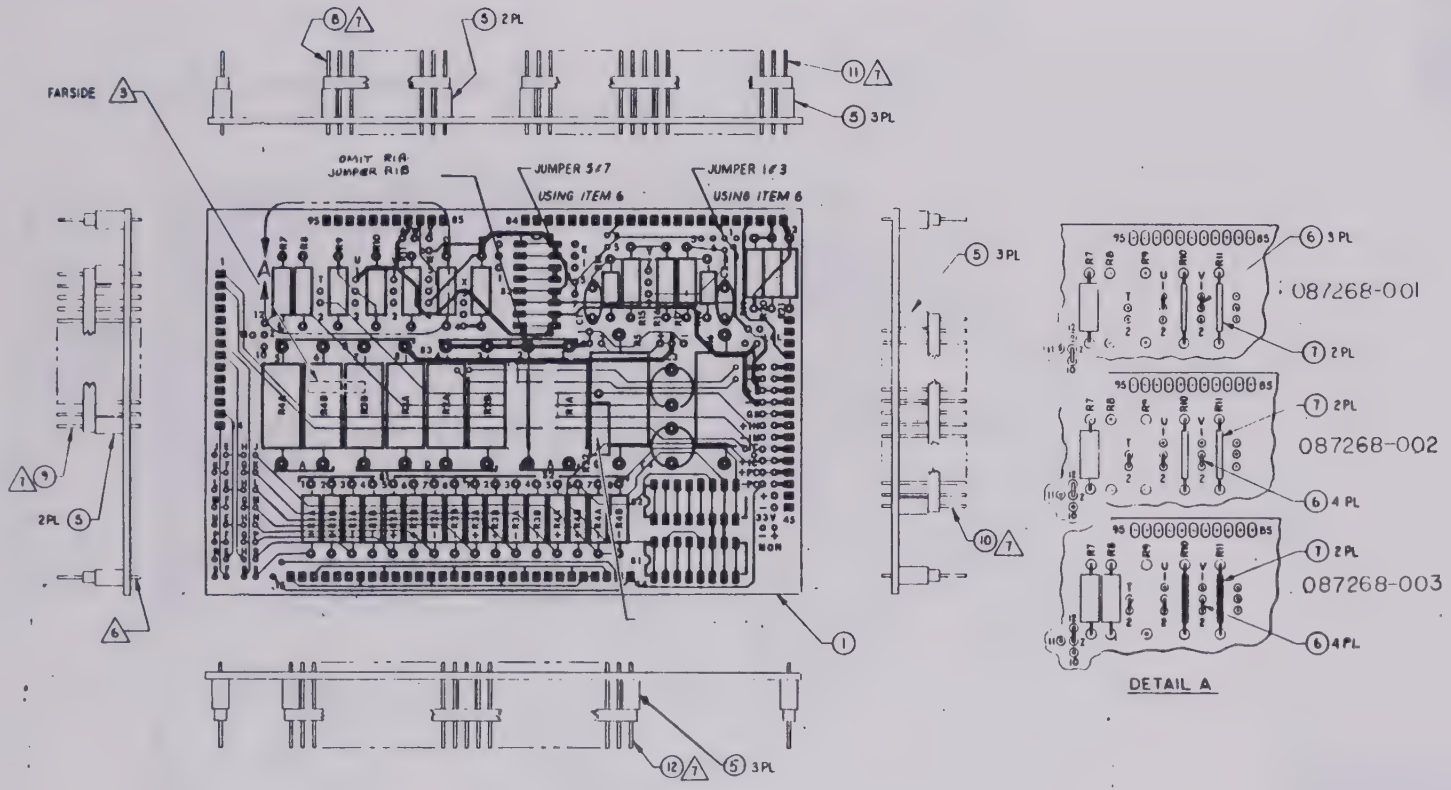
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



DETAIL A

DETAIL B
SCALE: NONE

THIS P.C. BOARD IS USED FOR ALIGNMENT

⚠7 TO ALIGN PINS, ITEMS 8,9,10,11 & 12, USE A°086601 P.C. BOARD AS SHOWN IN DETAIL B.
⚠6 DO NOT TRIM LEADS ON ITEMS 8,9,10,11 & 12.

4. ONLY THOSE PARTS IN THE MATERIAL LIST ARE INSTALLED.
⚠5 MARK BOARD WITH LATEST REVISION LETTER, SERIAL NO. AND ASSY. DASH NO., IF APPLICABLE, IN LOCATION SHOWN. METAL STAMP OR VIBRO-ETCH.
2. MAXIMUM SOLDER OR LEAD EXTENSION ON OPPOSITE SIDE OF PC BOARD IS .06".
1. REF DWG'S: MATL LIST 087268, SCHEMATIC 087187, FABRICATION 087187, ARTWORK 087189.

NOTES:

QTY REQD PER ASSY	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	REFERENCE DESIGNATION	ITEM NO
			PARTS LIST		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES: DECIMALS .XX ± .015, .XXX ± .010; FRACTIONS ±; ANGLES ±; DO NOT SCALE DRAWING

CONTRACT NO.

400171-709	7600A		
NEXT ASSY	USED ON		
APPLICATION			

DR Schaad 2 — DATE 4/1/81
CHK
APPD — DATE 4/1/81
MFG — DATE

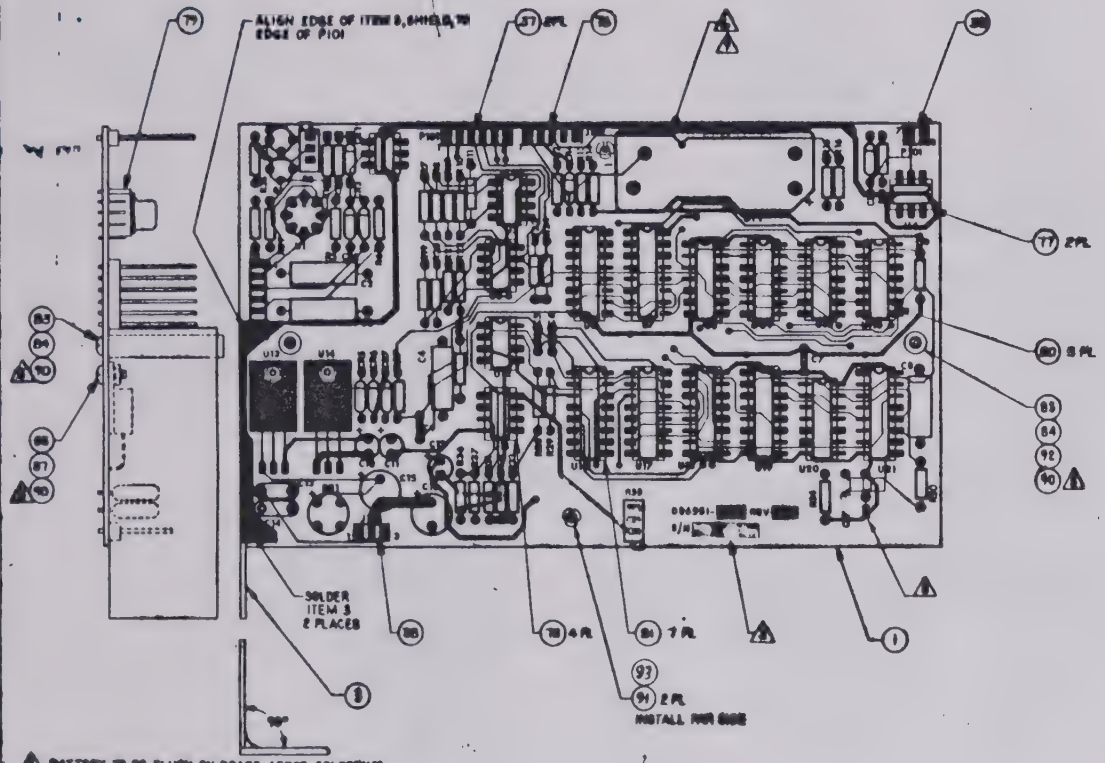
WAUGH CONTROLS CORPORATION
8001 FLEURY AVENUE • CHATSWORTH
CALIFORNIA 91311 • (213) 998-8781

ASSY, BRIDGE COMPLETION

SIZE D | CODE IDENT NO. | 087268 | REV

SCALE 2/1 | MODEL 7600A | BASIC | SHEET OF

087268



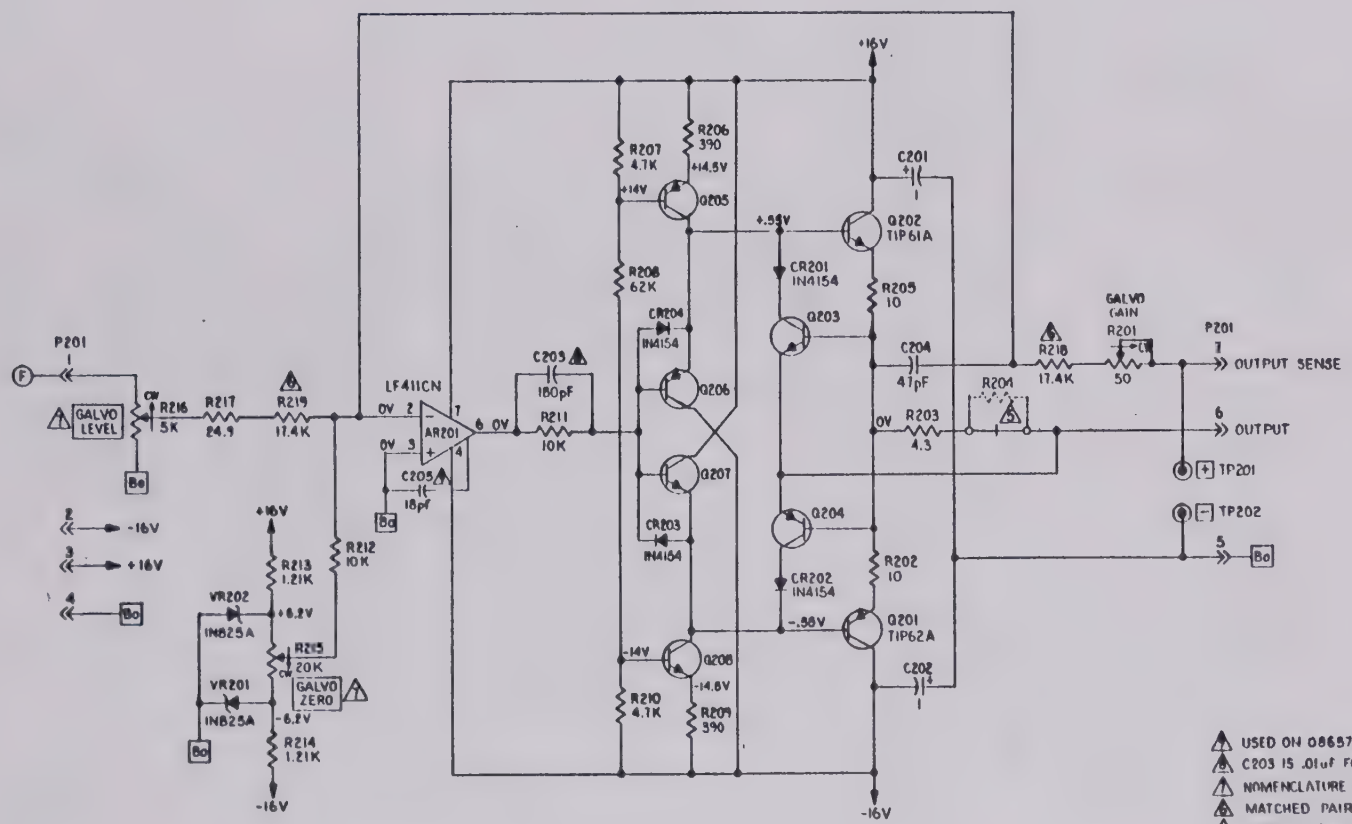
LTR	DESCRIPTION	DATE	APPROVED
A	INITIAL RELEASE	8-4-83	
B	ECO 6194		
C	ECO 6234		
D	ECO 6274		
E	ECO 6295		
F	ECO 6516		
G	ECO 6 350	3-6-84	
H	ECO 6 [illegible]		
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
M	ECO 7156	[illegible]	[illegible]
A	ECO 7186	[illegible]	[illegible]

TABULATION		
ASSY NO.	MATL LIST	SCHEMATIC
086551	086551	086622
086551-001	086551-001	086623
086551-002	086551-002	086624

1. BATTERY TO BE FLUSH ON BOARD AFTER SOLDERING.
2. INSTALL C176 C180 BENT OVER AS SHOWN
3. ALL COMPONENTS MAY BE FLOW SOLDERED
4. NOT INSTALLED AT THIS LEVEL. SHOWN FOR REFERENCE ONLY.
5. APPLY LOCTITE (ITEM 90) AFTER TIGHTENING HARDWARE.
6. ONLY THOSE PARTS ON MATERIAL LIST ARE INSTALLED
7. PRINT BOARD WITH LATEST REVISION LETTER, SERIAL NO. AND ASSY. NUMBER, IF APPLICABLE, IN LOCATION SHOWN. METAL STAMP OR VIBRO-ETCH.
8. [illegible] SOLDER TO LAND DIMENSION AS OPPOSITE SIDE OF BOARD IS .03.
9. REF DES'S, PARTS LIST SEE TAB , SCHEMATIC SEE TAB. FABRICATION DRAWING , ASSEMBLY DRAWING.

		PARTS LIST			
			ASSY, AUTO ZERO BD		
400171	A644A		SIZE D	DP 086551	REV N

DP 086551



⚠ USED ON 086574-001 ASSY ONLY.
⚠ C203 IS .01uf FOR 086574-001 ASSY
⚠ NOMENCLATURE IN BLOCKS INDICATE FRONT PANEL CONTROLS.
⚠ MATCHED PAIR.
⚠ USER INSTALLED CURRENT LIMIT.
4. UNMARKED PNP TRANSISTORS ARE MPSA55.
3. UNMARKED NPN TRANSISTORS ARE MPSA05.
2. ALL CAPACITORS ARE IN μF
1. ALL RESISTORS ARE IN OHMS.

NOTES:

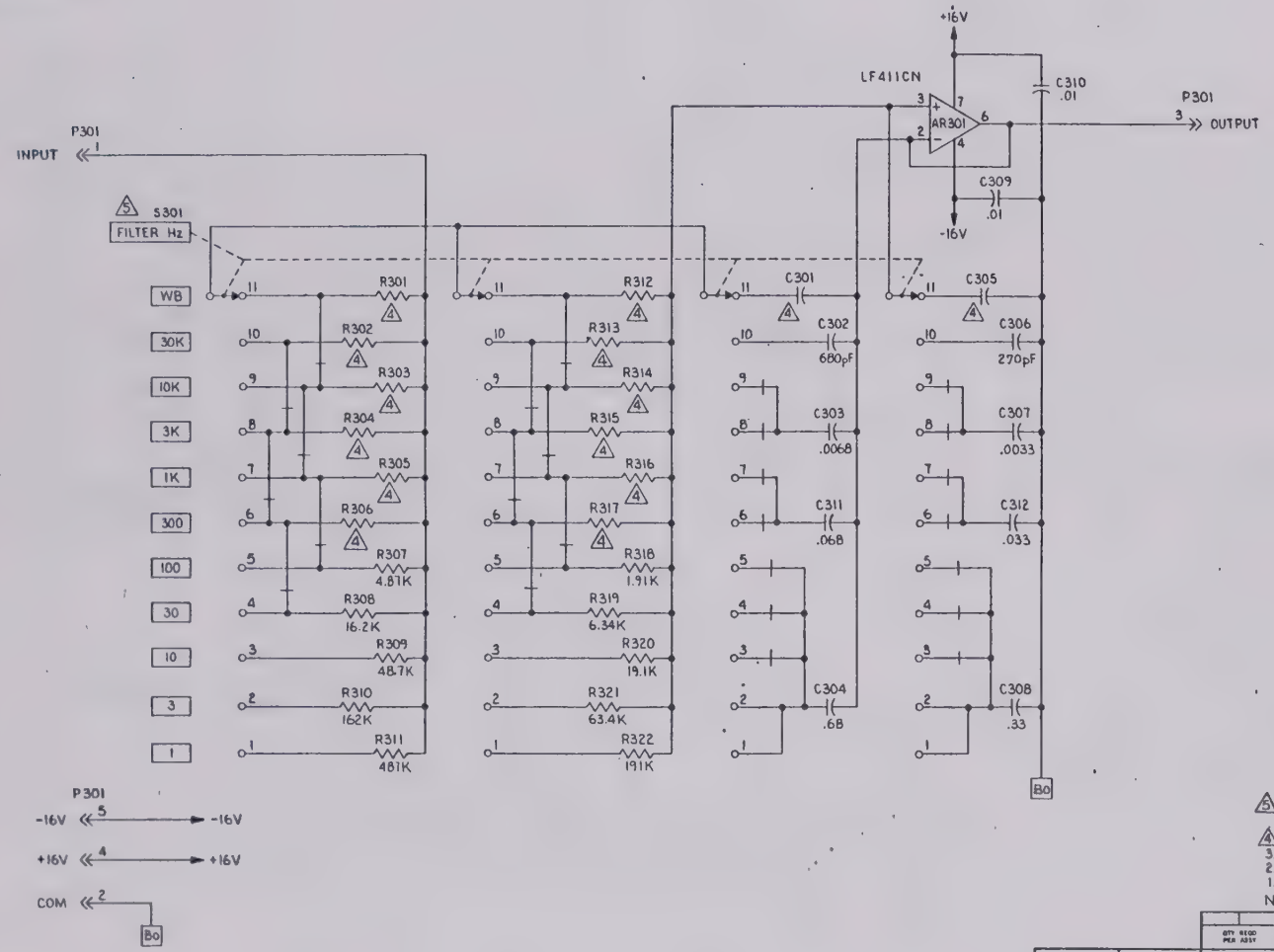
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ECO 8811 CHG R212 TO 10K		
B	ECO 9009		

SCHEMATIC
GALVO OUTPUT BOARD

086574 400171

D DS 086617 B

SCALE NONE



5 NOMENCLATURE IN BLOCKS INDICATE FRONT PANEL CONTROLS.

4 FOR FUTURE OPTIONAL USE.

3. ∤ INDICATES A POSSIBLE CUT TRACK FOR FUTURE USE.

2. ALL CAPACITORS ARE IN μF.

1. ALL RESISTORS ARE IN OHMS.

NOTES:

REVISIONS				
LTR	DESCRIPTION		DATE	APPROVED
A	INCORPORATED ECO# 6189	dd JM	7-27-83	
B	" " 6514	J.K	8-9-84	

PARTS LIST

QTY REQD PER ASSY	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	REFERENCE DESIGNATION	ITEM NO.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS .XX ± .010 .XXX ± .010
FRACTIONS ±
DO NOT SCALE DRAWING
MATERIAL
FINISH
APPLICATION
086573 NEXT ASSY
400171 USED ON

CONTRACT NO.
DR [signature] DATE 6/7/83
CHK E. Enriquez 6-29-83
APPD [signature] DATE 7-5-83
MFG DATE

WAUGH CONTROLS CORPORATION
8001 PALLMONT AVENUE • CHATSWORTH
CALIFORNIA 91311 • (213) 998 8781

SCHEMATIC
FILTER BOARD

SIZE D | CODE IDENT NO. | DS 086614 | REV B
SCALE NONE | MODEL 7600 A | BASIC | SHEET OF

DS 086614 B

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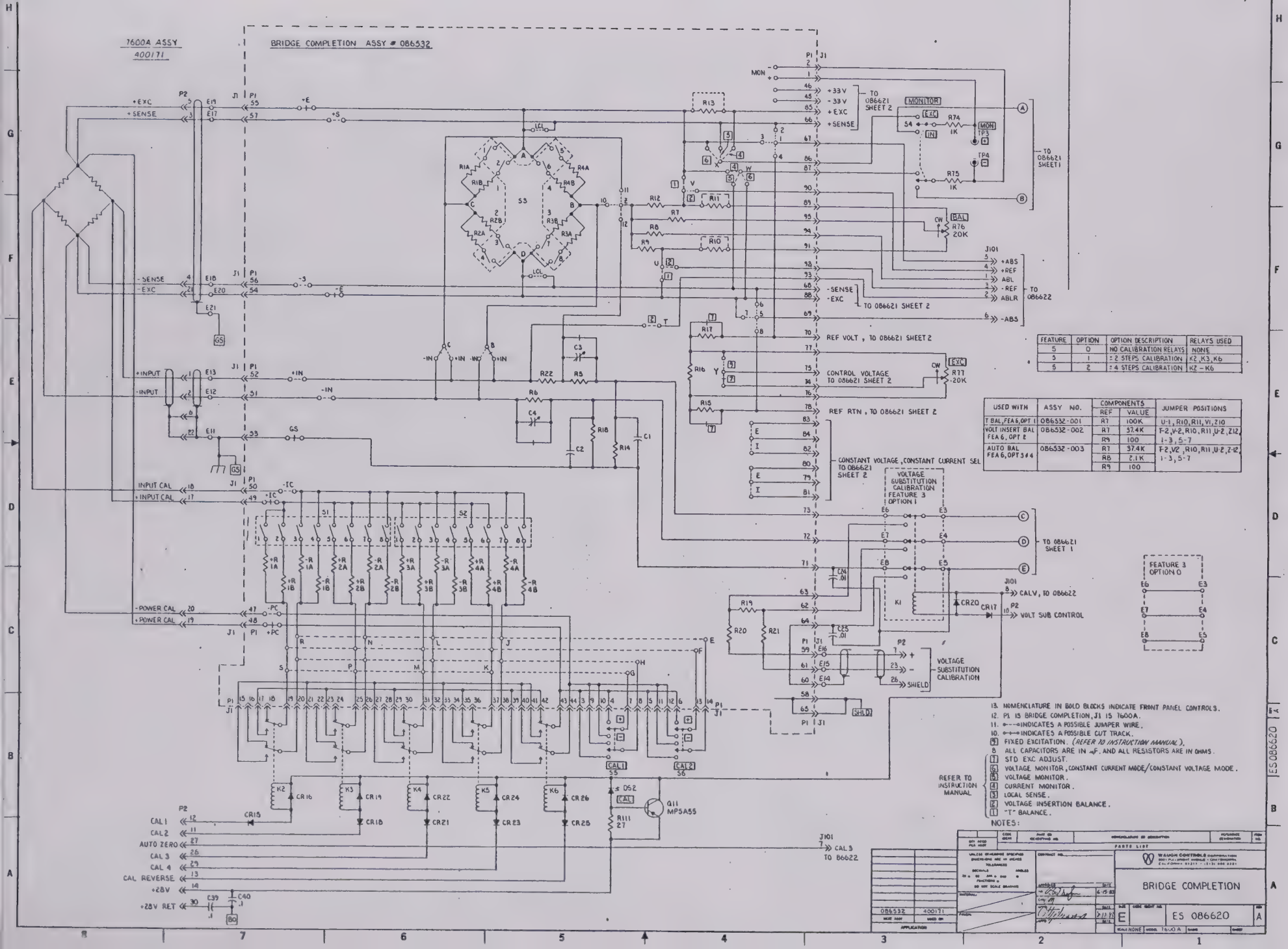


FEATURE	OPTION	OPTION DESCRIPTION	RELAYS USED
5	0	NO CALIBRATION RELAYS	NONE
5	1	± 2 STEPS CALIBRATION	K2, K3, K6
5	2	± 4 STEPS CALIBRATION	K2 - K6

USED WITH	ASSY NO.	COMPONENTS REF	COMPONENTS VALUE	JUMPER POSITIONS
T BAL, FEA 6, OPT 1	086532-001	R7	100K	U-1, R10, R11, V1, Z10
VOLT INSERT BAL FEA 6, OPT 2	086532-002	R7	37.4K	T-2, V-2, R10, R11, U-2, Z12
		R9	100	1-3, 5-7
AUTO BAL FEA 6, OPT 3 & 4	086532-003	R7	37.4K	T-2, V2, R10, R11, U-2, Z-12
		R8	2.1K	1-3, 5-7
		R9	100	

13. NOMENCLATURE IN BOLD BLOCKS INDICATE FRONT PANEL CONTROLS.
12. P1 IS BRIDGE COMPLETION, J1 IS 7600A.
11. ○---○ INDICATES A POSSIBLE JUMPER WIRE.
10. ○-/-○ INDICATES A POSSIBLE CUT TRACK.
9. FIXED EXCITATION. (REFER TO INSTRUCTION MANUAL).
8. ALL CAPACITORS ARE IN μF, AND ALL RESISTORS ARE IN OHMS.

REFER TO INSTRUCTION MANUAL

7. STD EXC ADJUST.
6. VOLTAGE MONITOR, CONSTANT CURRENT MODE/CONSTANT VOLTAGE MODE.
5. VOLTAGE MONITOR.
4. CURRENT MONITOR.
3. LOCAL SENSE.
2. VOLTAGE INSERTION BALANCE.
1. "T" BALANCE.

NOTES:

086532	400171		

WAVEK CONTROLS

BRIDGE COMPLETION

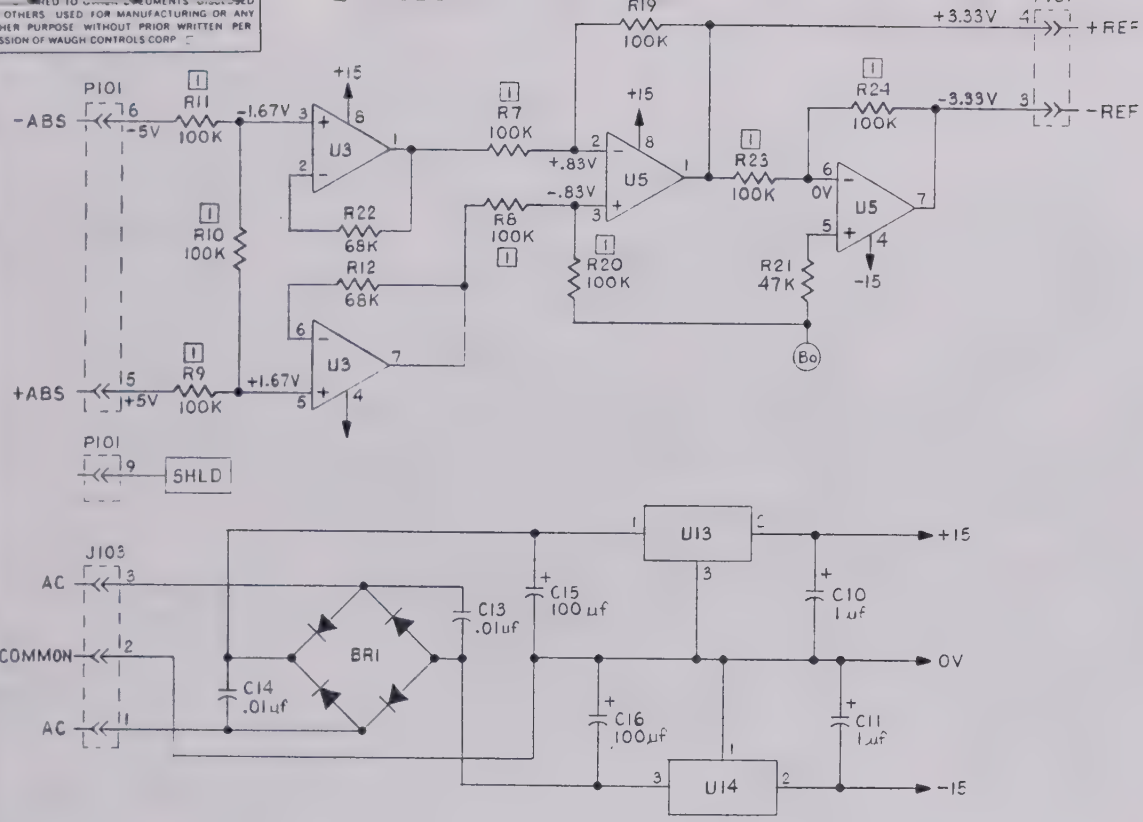
ES 086620 A

SCALE NONE MODEL 7600A

ES086620 A

TO OTHERS USED FOR MANUFACTURING OR ANY OTHER PURPOSE WITHOUT PRIOR WRITTEN PER MISSION OF WAUGH CONTROLS CORP

LTR	DESCRIPTION	DATE	APPROVED



2. FOR ASSEMBLY SEE 086551, MATL LIST 086551-002.

[1] MATCHED METAL FILM RESISTORS.

NOTES:

QTY REQD PER ASSY	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	REFERENCE DESIGNATION	ITEM NO

PARTS LIST

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS ANGLES
XX ± .015 XXX ± .010 ±
FRACTIONS ±
DO NOT SCALE DRAWING

MATERIAL:

FINISH:

CONTRACT NO.

		DATE
APPROVED		
DR	R. VANDERPOOL	8/31/59
CHK	E. Engberg	9-7-59
APPD		DATE 9-8-59
APPD		DATE

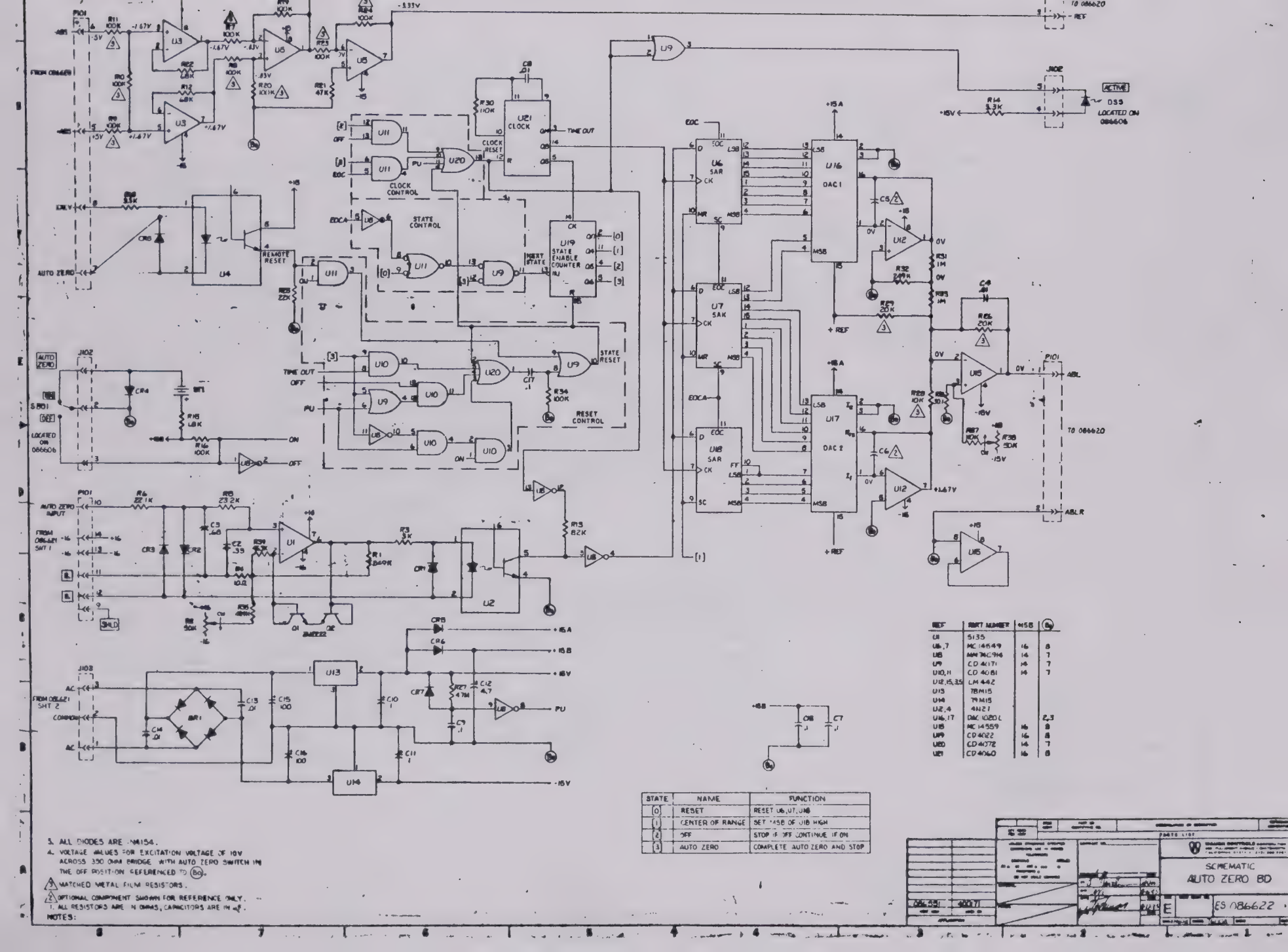
WAUGH CONTROLS CORPORATION
9001 FULLBRIGHT AVENUE • CHATSWORTH
CALIFORNIA 91311 • (213) 998 8281

SCHEMATIC, VOLTAGE INSERTION BALANCE

SIZE	CODE IDENT NO.		REV
C		086629	

SCALE | MODEL | BASIC | SHEET

086629



REF	PART NUMBER	MSB	Ⓑ
U1	5135		
U6,7	MC14549	16	8
U8	MM74C906	14	7
U9	CD4011	14	7
U10,11	CD4081	14	7
U12,15,35	LM442		
U13	TBM15		
U14	TBM15		
U2,4	4N21		
U16,17	DAC1020LC		2,3
U18	MC14559	16	8
U19	CD4022	16	8
U20	CD4072	14	7
U21	CD4060	16	8

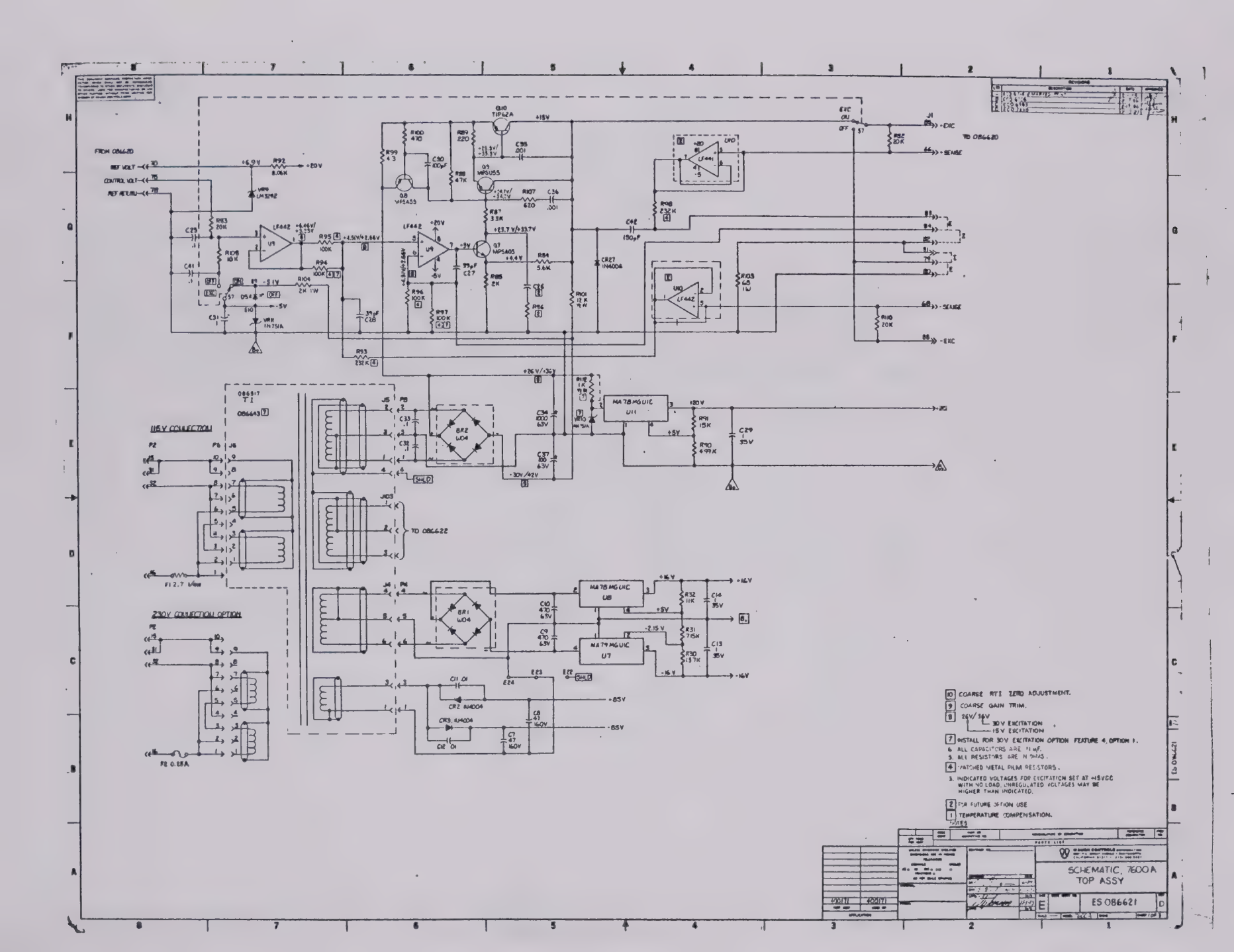
STATE	NAME	FUNCTION
0	RESET	RESET U6,U7,U8
1	CENTER OF RANGE	SET MSB OF U18 HIGH
2	OFF	STOP IF OFF CONTINUE IF ON
3	AUTO ZERO	COMPLETE AUTO ZERO AND STOP

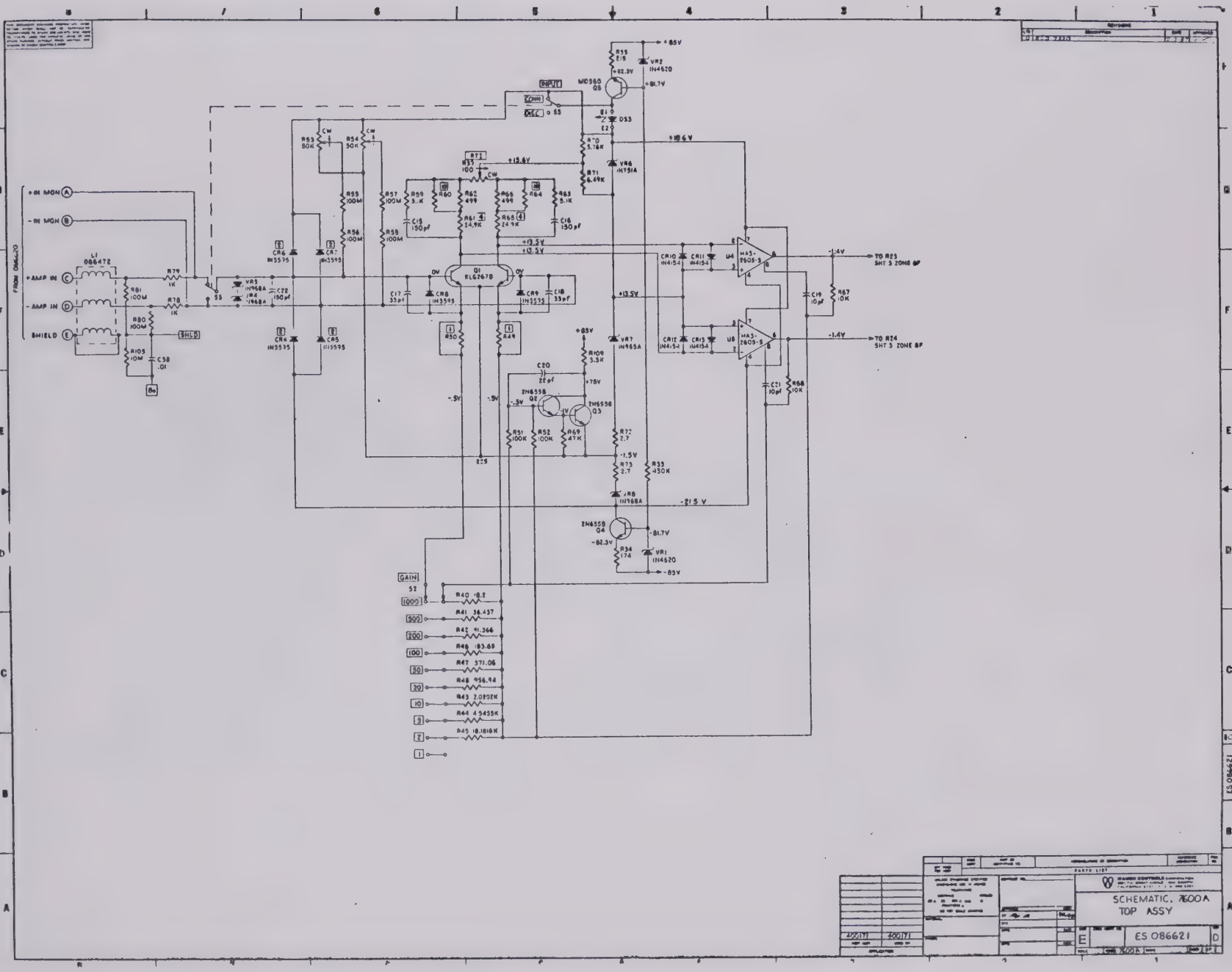
5. ALL DIODES ARE 1N4154.
4. VOLTAGE VALUES FOR EXCITATION VOLTAGE OF 10V ACROSS 350 OHM BRIDGE WITH AUTO ZERO SWITCH IN THE OFF POSITION REFERENCED TO Ⓑ.
3. MATCHED METAL FILM RESISTORS.
2. OPTIONAL COMPONENT SHOWN FOR REFERENCE ONLY.
1. ALL RESISTORS ARE IN OHMS, CAPACITORS ARE IN μF.

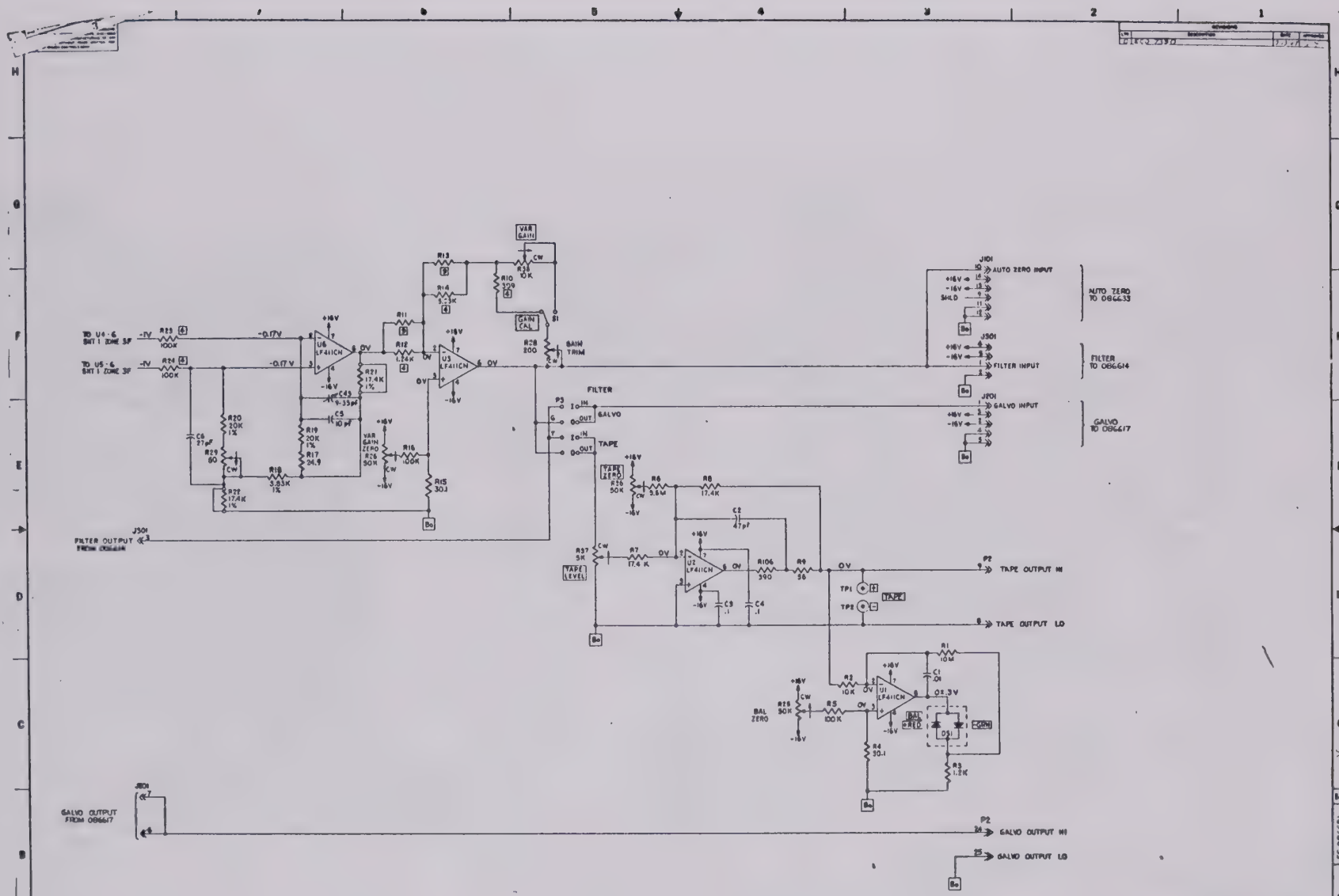
NOTES:

SCHEMATIC
AUTO ZERO BD

ES 086622


SCHEMATIC, 7600A
TOP ASSY
ES 086621
115V CONNECTION
230V CONNECTION OPTION
TO 086622
FROM 086620
NOTES
10 COARSE RTI ZERO ADJUSTMENT.
9 COARSE GAIN TRIM.
8 26V/36V 30V EXCITATION 15V EXCITATION
7 INSTALL FOR 30V EXCITATION OPTION FEATURE 4, OPTION 1.
6. ALL CAPACITORS ARE IN mF.
5. ALL RESISTORS ARE IN OHMS.
4 MATCHED METAL FILM RESISTORS.
3. INDICATED VOLTAGES FOR EXCITATION SET AT +15VDC WITH NO LOAD. UNREGULATED VOLTAGES MAY BE HIGHER THAN INDICATED.
2 FOR FUTURE OPTION USE
1 TEMPERATURE COMPENSATION.


SCHEMATIC, 7600A
TOP ASSY
ES 086621
+IN MON
-IN MON
+AMP IN
-AMP IN
SHIELD
INPUT
GAIN
+85V
-85V
+13.5V
-13.5V
-1.4V
-2.15 V
TO R23
SHT 3 ZONE 8F
TO R24
SHT 3 ZONE 8F
FROM D86620

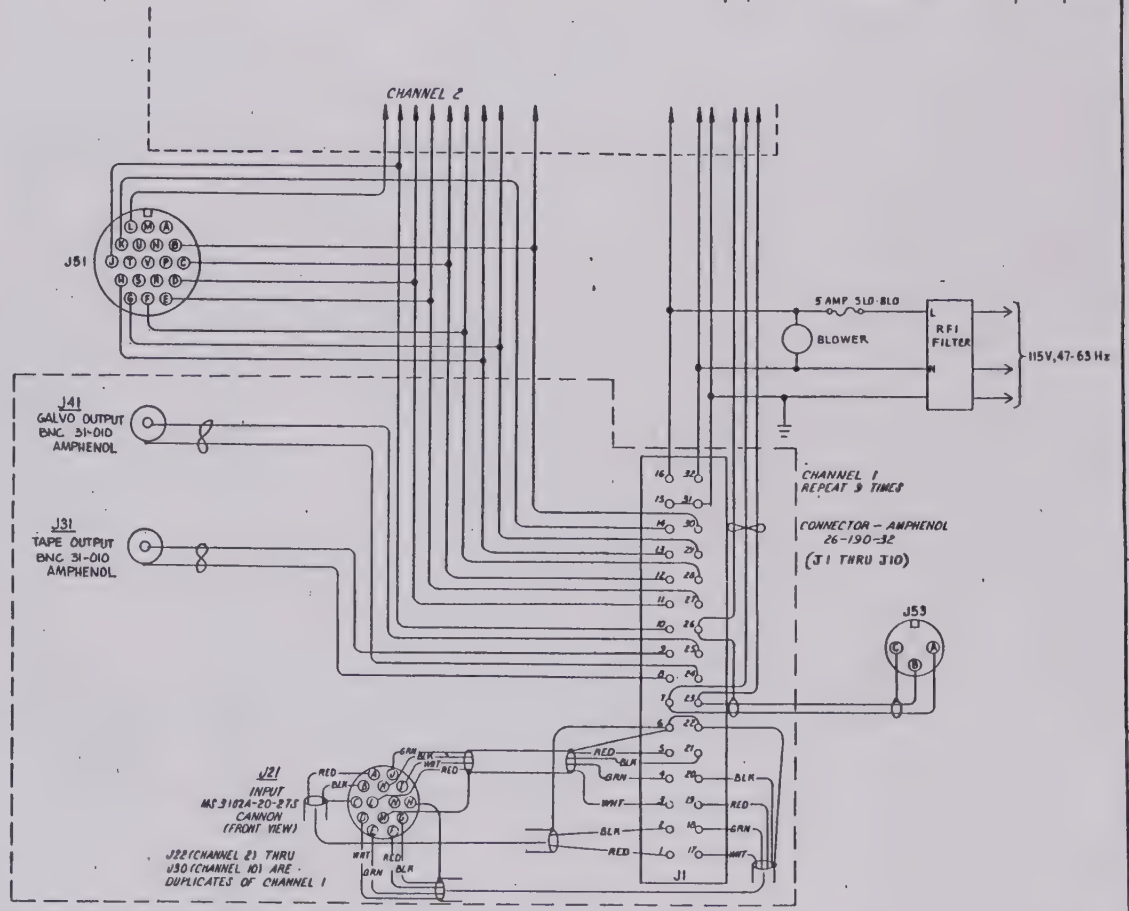

SCHEMATIC, 7600 A
TOP ASSY
ES 086621 D
AUTO ZERO INPUT
FILTER INPUT
GALVO INPUT
FILTER OUTPUT FROM 086614
GALVO OUTPUT FROM 086617
TAPE OUTPUT HI
TAPE OUTPUT LO
GALVO OUTPUT HI
GALVO OUTPUT LO
GAIN TRIM
FILTER
TAPE
GALVO
TAPE LEVEL
BAL ZERO
TAPE ZERO
VAR GAIN ZERO
VAR GAIN
GAIN CAL
LF411CN

FUNCTION	CONNECTOR MS3102A-20-27S J21 THRU J30	(26-190-32) AMPLIFIER CONNECTOR
INPUT		
+ INPUT	A	1
- INPUT	B	2
GUARD SHIELD	C	6
+ INPUT CAL	D	17
- INPUT CAL	E	18
+ POWER CAL	F	19
- POWER CAL	G	20
GUARD SHIELD	H	22
+ EXC SENSE	I	3
- EXC SENSE	J	4
-EXC	K	21
+EXC	L	5
GUARD SHIELD	M	6

FUNCTION	CONNECTOR MS3102A-22-14P J51	(26-190-32) AMPLIFIER CONNECTOR
CALIBRATION		
+28V DC	A	NO CONNECTION
+28V RETURN	B	30
CAL 1 CONTROL	C	12
CAL 2 CONTROL	D	11
AUTO ZERO	E	27
CAL 3 CONTROL	F	28
CAL 4 CONTROL	G	29
CAL REVERSE CONTROL	H	13
VOLTAGE SUB CONTROL	J	10
CHANNEL 1 SELECT	K	J1-14
CHANNEL 2 SELECT	L	J2-14
CHANNEL 3 SELECT	M	J3-14
CHANNEL 4 SELECT	N	J4-14
CHANNEL 5 SELECT	P	J5-14
CHANNEL 6 SELECT	R	J6-14
CHANNEL 7 SELECT	S	J7-14
CHANNEL 8 SELECT	T	J8-14
CHANNEL 9 SELECT	U	J9-14
CHANNEL 10 SELECT	V	J10-14

CHANNEL NO. J31-J50	FUNCTION	TAPE OUTPUTS FROM	TAPE OUTPUTS TO	GALVO OUTPUTS FROM	GALVO OUTPUTS TO
CHANNEL 1	OUTPUT	J1-9	J31 PIN	J1-25	J41 PIN
	RETURN	J1-8	J31 LUG	J1-24	J41 LUG
CHANNEL 2	OUTPUT	J2-9	J32 PIN	J2-25	J42 PIN
	RETURN	J2-8	J32 LUG	J2-24	J42 LUG
CHANNEL 3	OUTPUT	J3-9	J33 PIN	J3-25	J43 PIN
	RETURN	J3-8	J33 LUG	J3-24	J43 LUG
CHANNEL 4	OUTPUT	J4-9	J34 PIN	J4-25	J44 PIN
	RETURN	J4-8	J34 LUG	J4-24	J44 LUG
CHANNEL 5	OUTPUT	J5-9	J35 PIN	J5-25	J45 PIN
	RETURN	J5-8	J35 LUG	J5-24	J45 LUG
CHANNEL 6	OUTPUT	J6-9	J36 PIN	J6-25	J46 PIN
	RETURN	J6-8	J36 LUG	J6-24	J46 LUG
CHANNEL 7	OUTPUT	J7-9	J37 PIN	J7-25	J47 PIN
	RETURN	J7-8	J37 LUG	J7-24	J47 LUG
CHANNEL 8	OUTPUT	J8-9	J38 PIN	J8-25	J48 PIN
	RETURN	J8-8	J38 LUG	J8-24	J48 LUG
CHANNEL 9	OUTPUT	J9-9	J39 PIN	J9-25	J49 PIN
	RETURN	J9-8	J39 LUG	J9-24	J49 LUG
CHANNEL 10	OUTPUT	J10-9	J40 PIN	J10-25	J50 PIN
	RETURN	J10-8	J40 LUG	J10-24	J50 LUG

FUNCTION SUBSTITUTION VOLTAGE	CONNECTOR J53 MS3102A-10SL-3P	AMPLIFIER CONNECTOR J1	CONNECTOR J52 MS3102A-10SL-3P	AMPLIFIER CONNECTOR J10
+ INPUT	A	7	A	7
- INPUT	B	23	B	23
SHIELD	C	26	C	26



REVISIONS

LTR	DESCRIPTION	DATE	APPROVED

PARTS LIST

QTY REQD PER ASSY	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	REFERENCE DESIGNATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS .XX ± .010 .XXX ± .005
FRACTIONS ± 1/64
DO NOT SCALE DRAWING

MATERIAL
FINISH
NEXT ASSY | USED ON
APPLICATION

CONTRACT NO.

DYNAMICS

		DATE
APPROVED		
DR	P. Vanderpool	9/1/84
CHK	A. Macinga	3-8-85
APPD		3-7-85
MFG		DATE

SCHEMATIC, CABINET
7914AR/VX-2

SIZE	CODE IDENT NO.	086668	REV
D			

SCALE | WEIGHT | SHEET 1 OF 1

086668

PARTS LIST

MODEL NO. 7600A

AL 400171
[ASSY. No.]

CHANGE RECORD SHEET

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
7-26-3			COMPUTER RELEASE		
3-1-4	A	6227	CORRECT ERRORS		
3-1-4	B	6253	ADD PARTS		
3-1-4	C	6289	L/M CORRECTIONS		
3-9-4	D	6352	DELETE ITEMS		
9-17-4	E	6569	CHG QTY ITEM 0411		
12-18-4	F	6653	Chg L.E.D. Holder		
5-9-5	G	6736	Add Item 638		
9-23-6	H	7143	Chg Item 60 Add Item 611		
5-19-8	H1	7464	Add OPTIONS		
5-31-8	J		Add Item 22		
6-26-8	J1		Add K3 TO Item 511		
8-10-8	J2	7483	Chg Item 211		
9-11-9	J3		CHG Item 611 FEA 6 OPTS	1, 2, 3 & 4	
6-4-90	J4		ADD FEA 2 OPT 2 & FILTER, ADD ITEM 116 CHG FEA 1 OPT 12		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 400171 CROSS REF ITEM DESCRIPTION ASSY TOP 7600A ENGR DRAW S-NO. */*/*/*/*/*/*/*/*/*/**/*/*/*/*/**/**/ DEP BATCH QTY 1 EFFEC 5/04/90 ITEM TYPE A UNIT MEAS EA LOW LEVEL 00 PLANNER

REF NBR	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER		QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0061	03	FS1077	4-40X0.187 MS FIL PH SS			2.000	EA	4C					
0062	04	FS1079	4-40X0.375 MS FIL PH SS			2.000	EA	4C					
0011	02	FS3037	NUT,HEX,BR 0.312-32 C.10THKNHS	1256		1.000	EA	4C				1/25/84	
0040	03	FS5036	LED,HOLDERS NATURAL			2.000	EA	4C				12/18/84	
0020	03	039579-1	HANDLE 7526A/7600A	DEP	PURCH	1.000	EA	2C				6/21/83	
0080	04	086589	S/N TAG(LARGE)	DEP		1.000	EA	4C					
0001	04	086519	SYSTEM ASSEMBLY 7600A	DEP		1.000	EA	1C					
0100	01	086534	7600A FEAT GALVO OUTPUT	DEP	FEATURE 1	NON-REQD		FC				4/19/83	
0110	02	086521	7600A F1 OPT1 GALVO OUTPUT	DEP		1.000	EA	0	1			4/18/83	
0112	00	FS1039	4-40X0.250 MS PAN PH SS			1.000	EA	4				2/24/84	
0111	04	*086574	ASSY, GALVO OUTPUT 7600A	DEP		1.000	EA	1					
	02	087250	7600A F1 OPT2 AC/DC GALVO	DEP		1.000	EA	0	2			5/19/88	
0115	0E	FS1037	4-40X0.250 MS PAN PH SS			1.000	EA	4				5/19/88	
0114	03	087298	ASSY,AC/DC OUTPUT 7600A	DEP		1.000	EA	1				5/04/90	
0116	04	239095	NUT,DECORATIVE 3/8-32	ALC	N-1C	1.000	EA	4				5/04/90	
0200	01	086535	7600A FEATURE 2 FILTER	DEP	FEATURE 2	NON-REQD		FC				4/18/83	
0210	02	086525	7600A F2 OPT1 FILTER 11 POSDEP			1.000	EA	0	1			4/18/83	
0211	03	086576	ASSY, FILTER 11 POS 7600A	DEP		1.000	EA	1				8/15/86	
	02	087285	7600A,FEA 2 OPT 2 FILTER	DEP		1.000	EA	0	2			5/04/90	
	03	086040	ASSY,FILTER-6 POS,6 POLE	DEP		1.000	EA	1				5/04/90	
0300	01	086536	7600A FEA3 VOLT SUB CALBRT		FEATURE 3	NON-REQD		FC				4/18/83	
0310	02	086527	7600A F3 OPT1 VOLT SUB CAL	DEP		1.000	EA	0	1			4/18/83	
0313	00	FS4020	TIE WRAP			1.000	EA	4				1/25/84	
0312	04	FS6290	CABLE,2 COND BRAID SH	ALP	7522A OR EQUIV	1.500	FT	4				1/25/84	
0311	04	236084	RELAY,4PDT 24VDC K1	ARO	NF4E-24V	1.000	EA	4				3/31/83	
0400	01	086537	7600A FEATURE 4 EXCITATION		FEATURE 4	NON-REQD		FC				4/18/83	
0410	02	086528	F4 OPT1 30V EXCITATION	DEP		1.000	EA	0	1			4/18/83	
0411	04	086420-013	RESISTORS-MATCHED PR 100K R96,R97	DEP		1.000	PR	2				11/16/83	
0500	01	086538	7600A FEATURE 5 SHUNT CAL		FEATURE 5	NON-REQD		FC				4/18/83	
0520	04	086543	7600A F5 OPT1 CAL 2 STEPS	DEP		1.000	EA	0	1			4/18/83	
0511	04	236330	RELAY,2 FORM C, 24V DIP K2,K3,K6	MCX	190-22C100	3.000	EA	4				7/26/88	
0520	02	086544	7600A F5 OPT2 CAL 4 STEPS	DEP		1.000	EA	0	2			4/18/83	
0521	04	236330	RELAY,2 FORM C, 24V DIP K2-K5	MCX	190-22C100	3.000	EA	4				8/16/83	
0600	01	086540	7600A FEA6 BRIDGE BALANCE		FEATURE 6	REQUIRED		FC				4/19/83	
0610	02	086546	7600A F6 OPT1 MANUAL T BAL	DEP		1.000	EA	0	1			4/18/83	
0611	03	087260-001	ASSY,BRDG COMP MAN T	DEP		1.000	EA	0				9/07/89	
0001	04	087260-003	ASSY,BRIDGE COMPLETION MAKE INTO 087260-002, REPLACE R7 WFS REMOVE W2, INSTALL JUMPER PER 087260	DEP		1.000	EA	1				9/07/89	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 400174 CROSS REF ITEM DESCRIPTION ASSY TOP 7600A ENGR DRAW S-NO. */*/*/*/*/*/*/*/*/*/*/**/*/*/*/*/**/*/ DEP BATCH QTY 1 EFFEC 5/04/90 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL CO PLANNER

REF NOR	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0002	00	232040	RESISTOR K 1/10W 1% 37	RN55C1002F	1.000	EA	4				8/17/83	
0620	00	006547	7600A F6 OPT2 MAN VOLT INS	DEP	1.000	EA	0	2			4/18/83	
0623	00	FS1039	4-40X0.250 MS PAN PH SS		2.000	EA	4				2/24/84	
0113	05	FS5010	LOCTITE,CLEAR	LOC 420	.000	EA	4					
0622	03	006551-002	VOLTAGE INSERTION BALANCE	DEP	1.000	EA	1					
0621	03	007260-002	ASSY,BRDG COMP VOLTS INS	DEP	1.000	EA	0				9/07/89	
0001	04	007250-003	ASSY,BRIDGE COMPLETION MAKE INTO 007260-002, REMOVE R8 RES.	DEP	1.000	EA	1				9/07/89	
0630	02	006540	7600A F6 OPT AUTOBAL W/O BAT	DEP	1.000	EA	0	3			4/18/83	
0623	00	FS1039	4-40X0.250 MS PAN PH SS		2.000	EA	4				2/24/84	
0634	03	FS0032	LED,HOLDERS NATURAL		1.000	EA	4				12/18/84	
0622	04	006551	ASSY,AUTO BAL 7600A	DEP	1.000	EA	1				8/16/83	
0635	04	006607	CABLE, FLEX AUTO ZERO 7600A		1.000	EA	4				1/25/84	
0611	04	007260-003	ASSY,BRIDGE COMPLETION	DEP	1.000	EA	1				9/07/89	
0636	04	230975	SWITCH,TOGGLE S001	CAK 7101SYCB	1.000	EA	4				1/25/84	
0637	04	231039	LED LED 001	NAT NSL50 7	1.000	EA	4				1/25/84	
0638	03	256534	SPACER,NYL.047ID.156OD.25LG0IV	903-.250	1.000	EA	4				4/03/84	
0640	02	006549	7600A F6 OPT AUTO BAL W/BAT	DEP	1.000	EA	0	4			4/21/83	
0623	00	FS1039	4-40X0.250 MS PAN PH SS		2.000	EA	4				2/24/84	
0113	05	FS5010	LOCTITE,CLEAR	LOC 420	.000	EA	4					
0634	03	FS0032	LED,HOLDERS NATURAL		1.000	EA	4				12/18/84	
0622	03	006551-002	ASSY,AUTO VOLTAGE INS BAL		1.000	EA	0					
0001	04	006551	ASSY,AUTO BAL 7600A	DEP	1.000	EA	1				9/20/83	
0002	03	234750	BATTERY	GE DS250	1.000	EA	4				9/08/83	
0635	04	006607	CABLE, FLEX AUTO ZERO 7600A		1.000	EA	4				1/25/84	
0611	04	007260-003	ASSY,BRIDGE COMPLETION	DEP	1.000	EA	1				9/07/89	
0636	04	230975	SWITCH,TOGGLE S001	CAK 7101SYCB	1.000	EA	4				1/25/84	
0637	04	231039	LED LED 001	NAT NSL50 7	1.000	EA	4				1/25/84	
0638	03	256534	SPACER,NYL.047ID.156OD.25LG0IV	903-.250	1.000	EA	4				5/02/85	
0700	01	006552	7600A FEATURE 7 POWER	FEATURE 7	REQUIRED		FC				4/18/83	
0720	02	006553	7600A F7 OPT1 115V POWER	DEP	1.000	EA	0	1			4/18/83	
0720	02	006554	7600A F7 OPT2 230V POWER	DEP	1.000	EA	0	2			4/18/83	
0721	04	231464	FUSE,1/4 AMP	LTF 270.250	1.000	EA	4					
0800	01	006555	7600A FEATIFRONT PANEL MASK	FEATURE 11	REQUIRED		FC				4/18/83	
0810	02	006556-002	7600A F11 OPTIFRNT PNL MASK	DEP	1.000	EA	0	01			4/18/83	
0811	03	006557-002	MASK 7600A, NO OPTIONS	DEP	1.000	EA	9				6/24/83	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 400171 CROSS REF ITEM DESCRIPTION ASSY TOP 7600A DEP BATCH QTY 1 ITEM TYPE 1 LOW LEVEL 00
ENGR DRAW EFFEC 5/04/90 UNIT MEAS EA PLANNER
S-NO. */*/*/*/*/*/*/*/*/**/*/*/*/*/**/**/

REF NBR	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0820	02	086550-003	7600A F11 OPT2FRNT PNL MASKDEP		1.000	EA	0	02			4/18/83	
0811	03	086557-003	MASK 7600A AZ DEP		1.000	EA	2				6/24/83	
0830	02	086550-011	7600A F11 OPT3FRNT PNL MASKDEP		1.000	EA	0	03			4/18/83	
0811	03	086557-011	MASK 7600A FILTER DEP		1.000	EA	2				6/24/83	
0840	02	086550-013	7600A F11 OPT4FRNT PNL MASKDEP		1.000	EA	0	04			4/18/83	
0811	03	086557-013	MASK 7600A FILTER AZ DEP		1.000	EA	2				6/24/83	
0850	02	086550-103	7600A F11 OPT5FRNT PNL MASKDEP		1.000	EA	0	05			4/18/83	
0811	03	086557-103	MASK 7600A GALVO DEP		1.000	EA	2				6/24/83	
0860	02	086550-103	7600A F11 OPT6FRNT PNL MASKDEP		1.000	EA	0	06			4/18/83	
0811	03	086557-103	MASK 7600A GALVO AZ DEP		1.000	EA	2				6/24/83	
0870	02	086550-111	7600A F11 OPT7FRNT PNL MASKDEP		1.000	EA	0	07			4/18/83	
0811	03	086557-111	MASK 7600A GALVO FILTER DEP		1.000	EA	2				6/24/83	
0880	02	086550-113	7600A F11 OPT8FRNT PNL MASKDEP		1.000	EA	0	08			4/18/83	
0811	03	086557-113	MASK 7600A GALVO FILTER AZ DEP		1.000	EA	2				6/24/83	
	02	086550-201	7600A F11 OPT9FRNT PNL MASKDEP		1.000	EA	0	09			5/19/88	
0811	03	086557-201	MASK 7600A AC/DC DEP		1.000	EA	9				5/19/88	
	02	086550-203	7600A F11 OPT10 FRONT PANELDEP		1.000	EA	0	10			5/19/88	
0811	03	086557-203	MASK 7600A AC/DC & OFFSET DEP		1.000	EA	9				5/19/88	
	02	086550-211	7600A F11 OPT11 FRONT PANELDEP		1.000	EA	0	11			5/19/88	
0811	03	086557-213	MASK 7600A AC/DC & FILTER DEP		1.000	EA	9				5/19/88	
	02	086550-215	7600A,F11 OPT12 FRONT PANELDEP		1.000	EA	0	12			5/04/90	
0811	03	086557-215	7600A,MASK AC/DC FILT OFFSTDEP		1.000	EA	2				5/04/90	
0060	01	086003	SIDE COVER 7600A		1.000	EA	2C				9/23/86	
0000	04	086021	SCHEMATIC		.000	EA	3C					
0000	01	086031	CROSS REF LIST DEP		.000	EA	3C					
0000	01	086035	TEST PROCEDURE DEP		.000	EA	3C					
0000	01	086634	TEST DATA RECORD DEP		.000	EA	3C					
0064	01	087048	COVER,RIGHT SIDE 7600A DEP		1.000	EA	2C				9/23/86	
0010	04	230158	FASTENER STC 27-99-123-10		1.000	EA	4C				6/21/83	
0022	04	230391	LUG STC 110-256		1.000	EA	4C				5/31/88	
0031	02	231791	KNOB,LOCKING RAY KL-70-16 FOR R76		1.000	EA	4C				6/21/83	
0030	02	231818	KNOB RAY 70-1-26 FOR R76		1.000	EA	4C				6/21/83	
0050	04	233429	LOCKWASHER,INTERNAL TOOTH SKP 1218-02		1.000	EA	4C				6/21/83	
0070	02	236058	WASHER-SHOULDER-FIBER SSM 5604-105		1.000	EA	4C				6/21/83	

MODEL NO. 7600A

AL 86519
[ASSY. No.]

CHANGE RECORD SHEET

OK TM

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
7-26-3			COMPUTER RELEASE		
3-1-4	A	6210	CORRECT ERRORS		
3-1-4	B	6247	CHANGE ITEM 3		
3-1-4	C	6288	L/M CORRECTIONS		
3-9-4	D	6352	CHANGE ITEM 19		
3-17-6	E	7019	Change Item 19		
7-21-6	F	7082	MATCH ASSY REV.		
7-21-6	G	7112	Add Item 9		
10-10-6	H	7160	Delete Items 31 THRU 35		
2-17-7	J	7236	Chg Item 23		
6-16-7	K	7304	Chg Item 15		
7-10-7	L	7327	Add Item 37		
2-4-8	L1	7419	Chg Item 9 Add Item 10		
3-8-9	M		Chg Items 9 + 10		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM	CROSS REF ITEM	DESCRIPTION SYSTEM ASSEMBLY 7600A	DEP	BATCH QTY 1	ITEM TYPE 1	LOW LEVEL 02
086519		ENGR DRAW		EFFEC 3/08/89	UNIT MEAS EA	PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
	03	FS6288	CABLE,4 COND FOIL SH	MTN 412419FSVJ	1.500	FT	4				11/21/85	
	03	FS6330	CABLE,2 COND FOIL SH	MTN 212419FSVJ	1.500	FT	4				11/21/85	
0001	03	086520	ASSY MAIN PCB 7600A	DEP	1.000	EA	1				4/18/83	
0002	03	231229	CONN P2	AMP 26-159-32	1.000	EA	4				6/21/83	
0003	03	236695	HEADER,RT ANG LOCKING	MET 1100-9-110-01	1.000	EA	4				10/28/83	
0004	03	086610	FLEX-CABLE, INPUT W1 W1	DEP	1.000	EA	4					
0005	03	086518	FRONT PANEL 7600A	DEP	1.000	EA	2				6/17/83	
0006	05	233072	RESC 2.7 1/4W 5%	ALB RC07GF2R7J	1.000	EA	4				4/09/86	
0007	03	236059	INSERT,SHEET METAL F1	STC F1-10-104-13	2.000	EA	4				6/21/83	
0008	03	FS1241	2-56X1/4" SET SCREW CUP PT		1.000	EA	4				7/16/86	
0009	04	238849	KNOB,1/8" SHAFT S2	SLC S151-125	1.000	EA	4				3/03/89	
0011	03	236552	LUG FOR P2	ZIE 693-.144	1.000	EA	4				6/21/83	
0012	03	085964-2	RAIL-LOWER 7526A/7600A		1.000	EA	2				6/17/83	
0013	03	086598	RAIL,UPPER 7600A		1.000	EA	2				6/21/83	
0014	03	086599	REAR PLATE 7600A PLTD	DEP	1.000	EA	2				6/21/83	
0015	05	234640	SOCKET FOR F1	AGT LSG-2AG10-1	2.000	EA	4				6/16/87	
0016	04	FS5018	TAPE, DBL-BACK FOAM	3M 4408 1/8" X 1"	1.000	AR	4				7/13/83	
0017	03	FS5019	TAPE, FOAM	3M 4508 1/8"X3/4"	1.000	FT	4				7/13/83	
0018	06	FS4020	TIE WRAP		2.000	EA	4				1/27/84	
0019	03	086875	TRANSFORMER HI EXC 7600A T1	DEP	1.000	EA	2				3/04/86	
0020	06	FS3004	4-40 HEX NUT SM-PAT,SS		1.000	EA	4				7/13/83	
0021	04	FS1079	4-40X0.375 MS FIL PH SS		1.000	EA	4				7/13/83	
0022	03	FS1208	4-40X0.500 MS PAN PH SS		4.000	EA	4				1/27/84	
0023	03	FS1252	6-32 X .500 PAN PH TYPE F		8.000	EA	4				2/17/87	
0024	03	041639-2	WIRE RETAINER 7526A/7600A	DEP	2.000	EA	2				7/13/83	
0025	06	FS1039	4-40X0.250 MS PAN PH SS		1.000	EA	4				7/13/83	
0026	04	FS5017	LOCTITE, BLUE	LOC 242	.000	EA	4				7/13/83	
0028	04	234666	POTP# 20 K (PC MNT) R76	BOR 83A1DB28J16	1.000	EA	4				7/22/83	
0029	04	238850	CAP,KNOB 15MM	SLC C150	1.000	EA	4				3/07/89	
0036	03	234911	LED,RED LED601 LED1	IDI 5705H1	2.000	EA	4				1/27/84	
0037	03	234769	SETSCREW,FT PT 2-56 X 1/4"	AN565A2H4	1.000	EA	4				7/10/87	

MODEL NO. 7600A

AL 86520
[ASSY. No.]

CHANGE RECORD SHEET

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
7-26-3			COMPUTER RELEASE		
3-1-4	A	6202	DESIGN CHANGE		
3-1-4	B	6220	CHANGE ITEM 115		
3-1-4	C	6255	MATCH ASSY REV.		
3-1-4	D	6287	CORRECT L/M		
3-1-4	E	6314	CHANGE ITEMS 310 & 312		
3-1-4	F	6330	CHANGE ITEM 22		
3-9-4	G	6352	ADD ITEMS		
5-21-4	H	6407	CHANGE QTYS		
8-7-4	J	6504	MATCH ASSY REV		
10-3-4	K	6598	Chg Item 87		
4-18-4	L	6726	Chg Item 197, 205		
2-19-6	M	6983	Chg Item 260 Add Item 261		
10-10-6	N	7160	Add Items 273 Thru 277		
7-13-7	P	7329	Add Items 349 & 351 Chg Item 350		
8-12-7	Q	7348	Chg Item 117		
4-29	Q1	[redacted]	Chg Item 168 & 352		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086520 CROSS REF ITEM ENGR DRAW DESCRIPTION ASSY MAIN PCB 7600A DEP BATCH QTY 1 ITEM TYPE 1 LOW LEVEL 03
EFFEC 4/11/89 UNIT MEAS EA PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
	04	086520X	PCB ASSEMBLY SUBC LABOR 7600A		1.000	EA	4				2/02/88	
	06	236539	SOCKET,.02RD 20 POS. .1 CTRSAM	SS-120-T-2	.100	EA	4				3/26/85	
	06	236539	SOCKET,.02RD 20 POS. .1 CTRSAM	SS-120-T-2	.330	EA	4					
	06	236539	SOCKET,.02RD 20 POS. .1 CTRSAM	SS-120-T-2	.500	EA	4				3/26/85	
0000	04	086612	ARTWORK, P.C. BOARD	DEP	.000	EA	3				7/22/83	
0000	04	086621	SCHEMATIC		.000	EA	3				7/22/83	
0001	04	C86613	PC BOARD 7600A	DEP	1.000	EA	4				6/23/83	
0004	05	231280	DIOB 400 V 1.5A BR1,BR2	DI W04M	2.000	EA	4					
0006	04	233012	CAPC 10 PF 1KV10% CTB C19,C21,C5	DD-100	3.000	EA	4				2/19/86	
0008	04	233014	CAPC 22 PF 1KV10% CTB C20	DD-220	1.000	EA	4				8/24/83	
0010	04	233017	CAPC 27 PF 1KV10% CTB C6	DD-270	1.000	EA	4				2/19/86	
0012	04	233018	CAPC 33 PF 1KV 10% CTB C17,C18	DD-330	2.000	EA	4					
0014	05	233020	CAPC 47 PF 1KV10% CTB C2	DD-470	1.000	EA	4					
0016	06	233023	CAPC 100 PF 1KV10% CTB C30	DD-101	1.000	EA	4				8/24/83	
0018	04	233027	CAPC 150 PF 1KV10% CTB C15,C16,C22,C42	DD-151	4.000	EA	4				8/24/83	
0020	04	233019	CAPC 39 PF 1KV10% CTB C27, C28	DD-390	2.000	EA	4				8/24/83	
0022	06	233038	CAPC: .001 UF 1KV10% CTB C35,C36	DD-102	2.000	EA	4				2/21/84	
0023	05	236528	CAPC: .01 UF 100V20% CTB C1,C24,C25,C38	DC-103	4.000	EA	4				1/27/84	
0024	04	233040	CAPC: .01 UF 1KV10% CTB C11,C12	DD-103	2.000	EA	4				7/19/83	
0026	06	203043	CAPC: .1 UF 50V20% ERE C3,C4,C23,C39,C40,C41,C32,C33	RPE122Z5U104M	8.000	EA	4				1/27/84	
0034	04	236308	CAPE: 47 UF 160VAAA ILL C7,C8	476RMR160M	2.000	EA	4					
0036	04	236553	CAPE: 100 UF 63V RUB C37	63TTMS100M	1.000	EA	4				6/23/83	
0038	04	236306	CAPE: 470 UF 63VAAA RUB C9,C10	63TW470MS	2.000	EA	4				6/23/83	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086520 CROSS REF ITEM ENGR DRAW DESCRIPTION ASSY MAIN PCB 7600A DEP BATCH QTY 1 ITEM TYPE 1 LOW LEVEL 03 EFFEC 4/11/89 UNIT MEAS EA PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0040	04	236554	CAPE: 1000 UF 63V RUB 63TTMS1000M C34		1.000	EA	4				6/23/83	
0042	06	233871	CAPT: 1 UF 35V10% KEM T355A105K035AS C31,C13,C14,C29		4.000	EA	4				6/17/83	
0043	04	203040	CAPV 9-35 PF ERE 538-011-D-9-35 C43		1.000	EA	4				2/19/86	
0044	04	086472	CHOKE-INPUT FILTER 1-50MHZ DEP L1		1.000	EA	4					
0048	08	233381	DIOS 25 V D035 1N4154 CR10-CR13		4.000	EA	4					
0050	08	233382	DIOR 400 V 1.0A D041 1N4004 CR2,CR3,CR15-CR27		15.000	EA	4				6/29/83	
0052	04	236469	DIOX 6.9V TO92NAT LM329BZ VR9		1.000	EA	4				4/07/83	
0054	04	231289	DIOS 125 V D07 1N3595 CR8,CR9		2.000	EA	4					
0056	04	236076	DIOZ 3.3V 0.2W D035MOT 1N4620 VR1,VR2		2.000	EA	4					
0060	04	231338	DIOZ 5.1V 0.4W A1 1N751A VR11,VR6		2.000	EA	4				3/31/83	
0062	04	231355	DIOZ 15.0V 0.4W D07 1N965A VR7		1.000	EA	4					
0064	04	231357	DIOZ 20.0V 0.4W A196 1N968A VR8,VR3,VR4		3.000	EA	4				8/24/83	
0066	05	232354	DIOZ 30.0V 1.0W A1 1N4751A VR10		1.000	EA	4				3/06/84	
0070	04	236548	HEADER,8 PIN BRG 65610-108 P3		1.000	EA	4				6/20/83	
0071	05	236580	HEADER,RT ANG 4 PIN .025 SQMET 1100-9-104-01 P5		1.000	EA	4				6/29/83	
0072	04	236579	HEADER,STRGHT 6 PIN .025 SQMET 1100-8-106-01 P4		1.000	EA	4				6/29/83	
0073	04	236696	HEADER,6 PIN SAM TS-106-T-AA J2		1.000	EA	2				2/22/84	
0074	05	236697	HEADER,14 PIN SAM TS-114-T-AA J2		1.000	EA	4				2/22/84	
0075	04	236549	HEAT SINK TRL 61068-14 FOR Q10		1.000	EA	4				6/20/83	
0076	04	236678	HEAT SINK TRL 6073B FOR Q10		1.000	EA	4				8/24/83	
0077	04	236096	HEAT SINK CLIP-TO202 TRL 6046PB FOR Q4,Q5		2.000	EA	4					
0079	04	236097	HEAT SINK CLIP-TO202 WKF 291-C1-36-AP FOR U7,U8		2.000	EA	4				6/17/83	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086520 CROSS REF ITEM DESCRIPTION ASSY MAIN PCB 7600A DEP BATCH QTY 1 ITEM TYPE 1 LOW LEVEL 03
ENGR DRAW EFFEC 4/11/89 UNIT MEAS EA PLANNER

BOM ITEM	LL CO	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0082	04	236537	HOLDER,LED PC MOUNT FOR DS1,DS2	BIV 909-235	2.000	EA	4				6/16/83	
0085	05	236470	ICL OPAMP DUAL U9	DIPNAT LF442CN	1.000	EA	4				4/07/83	
0087	04	082349	IC-SELECTED	DEP	2.000	EA	4				10/02/84	
0089	05	236063	ICL OPAMP SGL-JFETINP U1,U2,U3,U6	NAT LF411CN	4.000	EA	4					
0091	04	236082	ICL VR -30V 0.5A ADJT0202FCD U7	UA79MGU1C	1.000	EA	4					
0095	06	235355	JUMPER,.1 CTR .025 SQR SKT FOR P3	EVR EDW254J	2.000	EA	4				6/20/83	
0097	06	231277	LED DS2	NAT NSL5046	1.000	EA	4				6/16/83	
0099	04	236536	LED,RED/GN T1 3/4 DS1	IDI 4301H1/5	1.000	EA	4				6/16/83	
0103	05	236576	PLUG,PLASTIC .125 HOLE	FTX 207-080501-00	2.000	EA	4				8/24/83	
0105	05	086480-002	POT * 5 K R37	DEP	1.000	EA	4					
0109	05	236083	POTT 50 R29	SPL 63P500	1.000	EA	4				6/17/83	
0111	04	230787	POTT 100 R39	SPL 43P101	1.000	EA	4					
0113	04	236084	POTT 200 3/8 SQ 18T R28	SPL 64W201	1.000	EA	4					
0115	05	086480-001	POT * 10K VAR R38	DEP	1.000	EA	4				9/06/83	
0117	05	234893	POTT* 20 K R77	BEK 78PR20K	1.000	EA	4				8/12/87	
0119	04	230799	POTT* 50 K R36	SPL 43P503	1.000	EA	4					
0121	04	230835	POTT* 50 K R53,R54,R25,R26	SPL 63P503	4.000	EA	4				6/17/83	
0130	05	233072	RESC 2.7 1/4W 5% R72,R73	ALB RC07GF2R7J	2.000	EA	4					
0131	04	233096	RESC 27 1/4W 5% R111	ALB RC07GF270J	1.000	EA	4				8/24/83	
0132	05	233077	RESC 4.3 1/4W 5% R99	ALB RC07GF4R3J	1.000	EA	4				7/19/83	
0133	04	233104	RESC 36 1/4W 5% R9	ALB RC07GF360J	1.000	EA	4				7/25/83	
0134	06	233118	RESC 220 1/4W 5% R89	ALB RC07GF221J	1.000	EA	4				4/07/83	
0135	05	233124	RESC 390 1/4W 5% R106	ALB RC07GF391J	1.000	EA	4				7/25/83	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086520 CROSS REF ITEM DESCRIPTION ASSY MAIN PCB 7600A DEP BATCH QTY 1 ITEM TYPE 1 LOW LEVEL 03
ENGR DRAW EFFEC 4/11/89 UNIT MEAS EA PLANNER

ROM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0136	05	233126	RESC 470 1/4W 5% ALB RC07GF471J R100		1.000	EA	4				7/25/83	
0137	04	233129	RESC 620 1/4W 5% ALB RC07GF621J R107		1.000	EA	4				8/24/83	
0138	06	233134	RESC* 1 K 1/4W 5% ALB RC07GF102J R78,R79,R74,R75		4.000	EA	4				8/24/83	
0139	05	233287	RESC* 1 K 1/2W 5% ALB RC20GF102J R112		1.000	EA	4				3/06/84	
0140	04	233136	RESC* 1.2 K 1/4W 5% ALB RC07GF122J R3		1.000	EA	4					
0142	06	233141	RESC* 2 K 1/4W 5% ALB RC07GF202J R85		1.000	EA	4				4/07/83	
0144	04	234057	RESC* 2 K ALB RC32GF202J R104		1.000	EA	4				7/19/83	
0145	06	232744	RESM* 10 K 1/10W 1% RN55C1002F R108		1.000	EA	4				1/27/84	
0146	05	233146	RESC* 3.3 K 1/4W 5% ALB RC07GF332J R87,R109		2.000	EA	4				8/24/83	
0148	06	233150	RESC* 4.7 K 1/4W 5% ALB RC07GF472J R88		1.000	EA	4				4/07/83	
0150	05	233151	RESC* 5.1 K 1/4W 5% ALB RC07GF512J R59,R63		2.000	EA	4				3/31/83	
0152	06	233152	RESC* 5.6 K 1/4W 5% ALB RC07GF562J R84		1.000	EA	4				4/07/83	
0154	06	233158	RESC* 10 K 1/4W 5% ALB RC07GF103J R2		1.000	EA	4				8/24/83	
0156	04	236399	RESC* 12 K 1/2W 5% ALB RC20GF1023J R101		1.000	EA	4				7/19/83	
0158	08	233174	RESC* 47 K 1/4W 5% ALB RC07GF473J R69		1.000	EA	4				7/19/83	
0160	04	233196	RESC*430 K 1/4W 5% ALB RC07GF434J R33		1.000	EA	4				6/17/83	
0164	04	233223	RESC: 5.6 M 1/4W 5% ALB RC07GF565J R6		1.000	EA	4					
0166	04	233229	RESC: 10 M 1/4W 5% ALB RC07GF106J R1,R105		2.000	EA	4				7/19/83	
0168	04	233253	RESC:100 M 1/4W 10% ALB RC07GF107K R55,R58,R80,R81		4.000	EA	4				4/11/89	
0170	05	086426-003	RES MTCH PR 17.4K DEP R7,R8		1.000	PR	2					
0172	04	086426-002	RES MTCH PR 24.9K DEP R61,R65		1.000	PR	2					
0174	04	086430	RES MTCH ST 2-20K 2-100K DEP R23,R24 ARE 100K R19,R20 ARE 20K		1.000	ST	2				6/08/83	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
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PARENT ITEM 086520 CROSS REF ITEM DESCRIPTION ASSY MAIN PCB 7000A DEP BATCH QTY 1 ITEM TYPE 4 LOW LEVEL 03
ENGR DRAW EFFEC 4/11/89 UNIT MEAS EA PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0176	04	086499	RES MTCH ST 309,5.23K,1.24KDEP R11 IS 309 R12 IS 1.24K R14 IS 5.23K		1.000	ST 2					
0185	05	232494	RESM 24.9 1/10W 1% R17	RN55C24R9F	1.000	EA 4				6/20/83	
0187	05	232502	RESM 30.1 1/10W 1% R4,R15	RN55C30R1F	2.000	EA 4				7/19/83	
0189	04	232575	RESM 174 1/10W 1% R34	RN55C1740F	1.000	EA 4					
0191	04	232584	RESM 215 1/10W 1% R35	RN55C2150F	1.000	EA 4					
0193	05	232619	RESM 499 1/10W 1% R62,R66	RN55C4990F	2.000	EA 4					
0197	04	232726	RESM* 6.49 K 1/10W 1% R71	RN55C6491F	1.000	EA 4				4/18/85	
0201	06	232715	RESM* 4.99 K 1/10W 1% R90	RN55C4991F	1.000	EA 4				3/31/83	
0203	05	232730	RESM* 7.15 K 1/10W 1% R31	RN55C7151F	1.000	EA 4					
0205	04	232721	RESM* 5.76 K 1/10W 1% R70	RN55C5761F	1.000	EA 4				4/18/85	
0206	04	232735	RESM* 8.06 K 1/10W 1% R92	RN55C8061F	1.000	EA 4				8/24/83	
0207	04	232748	RESM* 11 K 1/10W 1% R32	RN55C1102F	1.000	EA 4					
0209	06	232757	RESM* 13.7 K 1/10W 1% R30	RN55C1372F	1.000	EA 4					
0211	04	232761	RESM* 15 K 1/10W 1% R91	RN55C1502F	1.000	EA 4				3/31/83	
0213	06	232773	RESM* 20 K 1/10W 1% R82, R83, R110	RN55C2002F	3.000	EA 4				8/24/83	
0215	06	232840	RESM*100 K 1/10W 1% R51,R52,R5,R16	RN55C1003F	4.000	EA 4				8/24/83	
0216	04	086426-013	RESISTORS-MATCHED PR 100K DEP R95, R96		1.000	PR 2				8/24/83	
0218	04	086426-014	RESISTORS-MATCHED PR 232K DEP R93, R98		1.000	PR 2				8/24/83	
0225	04	221020	RESW 18.2 1/8W .025% IMP A39RL R40		1.000	EA 4					
0227	04	221025	RESW 36.437 1/8W .025% IMP A39RL R41		1.000	EA 4					

PRINT PHANTOM ITEMS
PRINT COMPONENTS
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PARENT ITEM 086520 CROSS REF ITEM DESCRIPTION ASSY MAIN PCB T600A ENGR DRAW DEP BATCH QTY 1 EFFEC 4/11/89 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 03 PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0229	04	236468	RESW 65 1W 1% IMP A06RL R103		1.000	EA	4				6/08/83	
0231	04	221036	RESW 91.366 1/8W .025% IMP A39RL R42		1.000	EA	4					
0233	04	221048	RESW 183.05 1/8W .025% IMP A39RL R46		1.000	EA	4					
0235	04	221064	RESW 371.06 1/8W .025% IMP A39RL R47		1.000	EA	4					
0237	04	221091	RESW 956.94 1/8W .025% IMP A39RL R48		1.000	EA	4					
0239	04	221113	RESW* 2.0202K 1/8W .025% IMP A39RL R43		1.000	EA	4					
0241	04	221155	RESW* 4.5455K 1/8W .025% IMP A39RL R44		1.000	EA	4					
0243	04	221206	RESW* 10 K 1/8W .025% IMP A39RL R67,R68		2.000	EA	4					
0245	04	221241	RESW* 18.1818K 1/8W .025% IMP A39RL R45		1.000	EA	4					
0250	04	236555	SOCKET,2 PIN J101	SAM SS-102-T-2	1.000	EA	0				6/23/83	
0254	05	236558	SOCKET,5 PIN STRIP .1 CNTR J301	SAM SS-105-T-2	1.000	EA	2				6/23/83	
0256	04	236559	SOCKET,6 PIN J101	SAM SS-106-T-2	2.000	EA	0				6/23/83	
0258	04	236560	SOCKET,7 PIN STRIP .1 CNTR J201	SAM SS-107-T-2	1.000	EA	0				6/23/83	
0260	06	234569	SOCKET,8 PIN DIP U1,U2,U3,U6,U9	RBN ICN-083-S3G	5.000	EA	4				2/19/86	
0261	05	230229	SOCKET,8 PIN (TO-5) FOR U4,U5	BRS 831-55022-084	2.000	EA	4				2/19/86	
0262	04	236542	SOCKET,11 PIN SIP J1	SAM SSW-111-01-G-S	1.000	EA	4				6/20/83	
0264	04	236543	SOCKET,14 PIN SIP J1	SAM SSW-114-01-G-S	1.000	EA	4				6/20/83	
0266	05	230220	SOCKET,16 PIN FOR K2-K6	RBN ICN-163-S3G	5.000	EA	4				6/16/83	
0268	04	236544	SOCKET,17 PIN SIP J1	SAM SSW-117-01-G-S	1.000	EA	4				6/20/83	
0270	04	236545	SOCKET,23 PIN SIP J1	SAM SSW-123-01-G-S	1.000	EA	4				6/20/83	
0272	04	236546	SOCKET,30 PIN SIP J1	SAM SSW-130-01-G-S	1.000	EA	4				6/20/83	
0273	04	086481	SWITCH-ROTARY 2 POLE 10 POSDEP S2		1.000	EA	4				10/10/86	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
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PARENT ITEM 086520 CROSS REF ITEM DESCRIPTION ASSY MAIN PCB 7600A ENGR DRAW DEP BATCH QTY 1 EFFEC 4/11/89 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 03 PLANNER

BOM ITEM	LL CO	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0274	04	236061	SWITCH,TOGGLE SPDT S1	CAK T101-S-T9-AV-B	1.000	EA	4				10/10/86	
0275	04	236062	SWITCH,TOGGLE-DPDT S3	CAK T201-M-H9-AV-B	1.000	EA	4				10/10/86	
0276	04	236582	SWITCH,TOGGLE S7	CAK 7201-S-D9-AV2-B	1.000	EA	4				10/10/86	
0277	04	236540	SWITCH,TOGGLE S4,S5,S6	CAK 7205-S-D9-AV2-B	3.000	EA	4				10/10/86	
0293	05	236066,	TEST POINT-BLACK .080 PROBE TP2,TP4	AGT 8046-1G6	2.000	EA	4				6/17/83	
0297	05	236065	TEST POINT-RED .080 PROBE TP1,TP3	AGT 8046-1G4	2.000	EA	4				6/17/83	
0300	04	231040	XSTR DUAL ML NPN HFE=350TO5 Q1	KLG KLG2678	1.000	EA	4					
0302	04	236071	XSTRP NPN 300V 10W TO202 Q2-Q4	MOT 2N6558	3.000	EA	4					
0304	04	231069	XSTRP PNP 60V 1W TO126 Q9	MOT MPSU55	1.000	EA	4				4/07/83	
0306	05	236068	XSTRP PNP 60V 15W TO220 Q10	MOT TIP30A	1.000	EA	4				4/07/83	
0308	04	236072	XSTRP PNP 300V 10W TO202 Q5	MOT MJE340	1.000	EA	4					
0310	06	231057	XSTRS NPN VCBO= 60 TO92 Q7	MOT MPSA05	1.000	EA	4				1/27/84	
0312	06	231061	XSTRS PNP VCBO= 60 TO92 Q8,Q11	MOT MPSA55	2.000	EA	4				1/27/84	
0340	04	239823	ICL VR 30V .9A ADJ TO202 U8,U11	FCD UA78MGU1C	2.000	EA	4				3/31/83	
0344	05	FS5016	LOCTITE,CLEAR	LOC 420	.001	EA	4				7/01/83	
0346	06	FS9019	THERMAL CONDUCTIVE COMPOUND FOR Q10	DOW 340	.001	EA	4				8/24/83	
0348	05	FS1041	4-40XG.375 MS PAN PH SS FOR Q10		1.000	EA	4				8/24/83	
0349	04	FS1040	4-40XG.312 MS PAN PH SS		1.000	EA	4				7/13/87	
0350	06	FS3013	4-40 ESNA NUT FOR Q10		2.000	EA	4				7/13/87	
0351	05	FS2015	#4 FW NYLON		2.000	EA	4				7/13/87	
0352	04	FS6268	WIRE,20 GA SOLID COPPER	ALP 297 OR EQUIV	.500	FT	4				5/07/84	
0354	06	FS5021	JUMPER R49,R50,R56,R58	STK RD-1/4-Z	4.000	EA	4				4/11/89	
0355	04	FS6266	WIRE,24 GA BUSS	ALP 299 OR EQUIV	.100	FT	4				7/06/83	
0356	04	FS1230	4-40XD.250 MS PANSLT NYLBLK FOR U11		1.000	EA	4				8/24/83	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086520 CROSS REF ITEM DESCRIPTION ASSY MAIN PCB 760JA ENGR DRAW DEP BATCH QTY 1 EFFEC 4/11/89 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 03 PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0358	05	FS3034	4-40 HEX NUT NYLON FOR U11	BLK	1.000	EA	4				8/24/83	

MODEL NO. 7600A

AL 0865-74
[ASSY. No.]

CHANGE RECORD SHEET

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
7-143			INITIAL RELEASE		
3-8-4	A	6211	CHANGE ITEM 22		
3-8-4	B	6293	CHG. ITEM 46 ADD 49		
3-23-4	C		CHANGE ITEMS		
10-26	D	7106	Chg Item 42		
8-12-7	E	7348	Chg Item 32		
1-16-9	E1		CHG ITEM 45		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086574 CROSS REF ITEM DESCRIPTION ASSY, GALVO OUTPUT 7600A DEP ENGR DRAW BATCH QTY 1 EFFEC 11/16/89 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 04 PLANNER

REF NBR	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0045	05	FS1040	4-40X0.312 MS PAN PH SS		1.000	EA	4C				11/16/89	
0046	05	FS1175	6-32X0.500 MS PAN SLT NYL NAT		2.000	EA	4C				3/21/84	
0049	05	FS2010	#6 FW FIBER		1.000	EA	4C				1/27/84	
0050	05	FS2015	#4 FW NYLON		1.000	EA	4C				3/21/84	
0047	06	FS5015	THERMAL CONDUCTIVE COMPOUNDDOW 340		.000	EA	4C				7/11/83	
0048	05	FS5016	LOCTITE,CLEAR LOC 420		.000	EA	4C				7/11/83	
0020	05	086426-003	RES MTCH PR 17.4K DEP R218,R219		1.000	PR	2C					
0031	05	086480-002	POT * 5 K DEP R216		1.000	EA	4C					
0000	05	086587	ARTWORK P.C. BOARD		.000	EA	3C				7/11/83	
0001	05	086588	PC BOARD GALVO OUT 7600A DEP		1.000	EA	4C				6/02/83	
0000	05	086617	SCHEMATIC, GALVO DEP		.000	EA	3C				6/30/83	
0000	05	086618	TEST PROCEDURE, GALVO DEP		.000	EA	3C				6/30/83	
0000	05	086619	TEST FIXTURE, GALVO DEP		.000	EA	3C				6/30/83	
0043	05	230280	STANDOFF,1/4" HEX X 7/8" ATN	8219-A-0632-0	2.000	EA	4C				6/01/83	
0036	06	231057	XSTRS NPN VCBO= 60 TO92MOT Q203,Q207,Q208	MPSA05	3.000	EA	4C					
0037	06	231061	XSTRS PNP VCBO= 60 TO92MOT Q204,Q205,Q206	MPSA55	3.000	EA	4C					
0016	05	231348	DIOX 6.2V DO14 VR201,VR202	1N825A	2.000	EA	4C					
0029	05	232494	RESM 24.9 1/10W 1% R217	RN55C24R9F	1.000	EA	4C				6/02/83	
0021	06	232656	RESM* 1.21 K 1/10W 1% R213,R214	RN55C1211F	2.000	EA	4C					
0022	06	232744	RESM* 10 K 1/10W 1%	RN55C1002F	1.000	EA	4C				8/23/83	
0011	05	233020	CAPC 47 PF 1KV10% CTB C204	DD-470	1.000	EA	4C					
0012	05	233028	CAPC 180 PF 1KV10% CTB C203	DD-181	1.000	EA	4C					
0023	05	233077	RESC 4.3 1/4W 5% ALB R203	RC07GF4R3J	1.000	EA	4C					
0024	05	233086	RESC 10 1/4W 5% ALB R202,R205	RC07GF100J	2.000	EA	4C					
0025	05	233124	RESC 390 1/4W 5% ALB R206,R209	RC07GF391J	2.000	EA	4C					
0026	06	233150	RESC* 4.7 K 1/4W 5% ALB R207,R210	RC07GF472J	2.000	EA	4C					
0027	06	233158	RESC* 10 K 1/4W 5% ALB R211	RC07GF103J	1.000	EA	4C					

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086574 | CROSS REF ITEM | DESCRIPTION ASSY, GALVO OUTPUT 7600A DEP | ENGR DRAW | BATCH QTY 1 | EFFEC 11/16/89 | ITEM TYPE 1 | UNIT MEAS EA | LOW LEVEL 04 | PLANNER

REF NBR	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UN	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0028	05	233177	RESC* 62 K 1/4W 5% ALB RC07GF623J R208		1.000	EA	4C					
0017	08	233381	DIOS 25 V D035 1N4154 CR201,CR202,CR203,CR204		4.000	EA	4C				7/11/83	
0013	06	233871	CAPT: 1 UF 35V10% KEM T355A105K035AS C201,C202		2.000	EA	4C					
0004	06	234569	SOCKET,8 PIN DIP RBV 1CN-083-S3G FOR AR201		1.000	EA	4C					
0032	05	234693	POTT* 20 K BEK 78PR20K R215		1.000	EA	4C				8/12/87	
0008	05	236063	ICL OPAMP SGL-JFETINP NAT LF411CN J201		1.000	EA	4C					
0005	05	236065	TEST POINT-RED .080 PROBE AGT 8046-1G4 TP201		1.000	EA	4C					
0006	05	236066	TEST POINT-BLACK .080 PROBEAGT 8046-1G6 TP202		1.000	EA	4C				6/24/83	
0038	05	236067	XSTRP NPN 60V 15W TO220 MOT TIP61A Q202		1.000	EA	4C					
0039	05	236068	XSTRP PNP 60V 15W TO220 MOT TIP30A Q201		1.000	EA	4C					
0033	05	236512	POTT 50 3/8 SQ 1T SPL 63X500T000 R201		1.000	EA	4C				6/02/83	
0033	05	236573	BOARD-TO-BOARD STRIP,7 PIN SAM BBS-107-G-D		1.000	EA	0				6/24/83	
	06	236510	BOARD-TO-BOARD STRIP,20 PINSAM BBS-120-G-D		.500	EA	4					
0042	05	237929	STANDOFF,1/4"RD X 1" PHEN ATM 8161-PH-0440		1.000	EA	4C				10/03/86	

MODEL NO. 7600A

AL 086573
[ASSY. No.]

CHANGE RECORD SHEET

OK TCH

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
7-14-3			INITIAL RELEASE		
3-6-4	A	6189	CHANGE ITEMS		
3-6-4	B	6248	CHANGE ITEM 30		
3-6-4	C	6292	ADD ITEM 33		
7-19-4	D	6481	MATCH ASSY REV.		
8-13-4	E	6584	CHG ITEM 12		
8-6-6	F	7125	Chg Items 32, 33 Add Item 34		
3-4-8	F1	7419	Chg Item 30, Add Item 31		
3-8-9	G		Chg Items 30 & 31		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086573 CROSS REF ITEM DESCRIPTION ASSY, FILTER 11 POS 7600A DEP ENGR DRAW BATCH QTY 1 EFFEC 3/08/89 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 03 PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0000	04	086585	ARTWORK, P.C. BOARD DEP		.000	EA	3				7/12/83	
0000	04	086614	SCHEMATIC, FILTER DEP		.000	EA	3				6/30/83	
0000	04	086615	TEST PROCEDURE, FILTER DEP		.000	EA	3				6/30/83	
0000	04	086616	TEST FIXTURE, FILTER DEP		.000	EA	3				6/30/83	
0001	04	086586	PC BOARD 7600A FILTER DEP		1.000	EA	4				6/02/83	
0003	04	236570	PIN,5 POS 1.085 X .02DIA P301	SAM BBS-105-G-D	1.000	EA	2				6/24/83	
0004	06	234569	SOCKET,8 PIN DIP FOR AR301	RBN 1EN-083-S3G	1.000	EA	4					
0007	05	236063	ICL OPAMP SGL-JFETINP AR301	NAT LF411CN	1.000	EA	4					
0008	04	236610	CAPY: .033 UF 250V 10%ILL C312	333MSR250K	1.000	EA	4				8/12/83	
0009	04	236611	CAPY: .068 UF 250V10% ILL C311	683MSR250K	1.000	EA	4				8/12/83	
0010	04	236612	CAPY: .33 UF 250V10% ILL C308	334MSR250K	1.000	EA	4				8/12/83	
0011	04	236608	CAPY: .0033 UF 100V10% ILL C307	332SHR100K59CE	1.000	EA	4				8/24/83	
0012	04	236577	CAPM .270 PF 300V 5% SNC C306	D105F271J0	1.000	EA	4					
0013	04	236613	CAPY: .68 UF 250V10% ILL C304	684MSR250K	1.000	EA	4				8/12/83	
0014	04	235145	CAPM 680 PF 300V 5% CDE C302	CD15FC681J03	1.000	EA	4				8/12/83	
0015	04	236609	CAPY: .0068 UF 100V10% ILL C303	682SHR100K59CE	1.000	EA	4				8/12/83	
0016	06	233041	CAPC: .01 UF 50VDDU CTB C309,C310	CK-103	2.000	EA	4				6/02/83	
0018	04	232675	RESM* 1.91 K 1/10W 1% R318	RN55C1911F	1.000	EA	4				8/12/83	
0019	04	232714	RESM* 4.87 K 1/10W 1% R307	RN55C4871F	1.000	EA	4				8/12/83	
0020	04	232725	RESM* 6.34 K 1/10W 1% R319	RN55C6341F	1.000	EA	4				8/12/83	
0021	04	232764	RESM* 16.2 K 1/10W 1% R308	RN55C1622F	1.000	EA	4				8/12/83	
0022	04	232810	RESM* 48.7 K 1/10W 1% R309	RN55C4872F	1.000	EA	4				8/12/83	
0023	04	232821	RESM* 63.4 K 1/10W 1% R321	RN55C6342F	1.000	EA	4				8/12/83	
0024	04	232860	RESM*162 K 1/10W 1% R310	RN55C1623F	1.000	EA	4				8/12/83	
0025	04	236607	RESM*487 K 1/10W 1% R311	RN55C4873F	1.000	EA	4				8/12/83	

~~PRINT PHANTOM ITEMS~~
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086573 CROSS REF ITEM DESCRIPTION ASSY. FILTER 11 POS 7600A DEP ENGR DRAW BATCH QTY 1 EFFEC 3/08/89 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 03 PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
~~0026~~	~~04~~	~~236606~~	~~RESM*191 K 1/10W 1%~~ R322	~~RN55C1913F~~	~~1.000~~	~~EA~~	~~4~~				~~8/12/83~~	
0027	04	232771	RESM* 19.1 K 1/10W 1% R320	RN55C1912F	1.000	EA	4				8/12/83	
0029	04	086637	SWITCH-ROTARY 4 POLE 11 POSDEP S301		1.000	EA	4				3/02/84	
~~0030~~	~~04~~	~~238852~~	~~.KNOB. 1/8" SHAFT LINE FOR S301~~	~~SLC S1U1-125~~	~~1.000~~	~~EA~~	~~4~~				~~3/06/89~~	
0031	04	238853	.CAP.KNOB 10MM	SLC C100	1.000	EA	4				3/07/89	
~~0032~~	~~05~~	~~FS1257~~	~~4-40X0.312 RD HD SLT NYLON~~		~~1.000~~	~~EA~~	~~4~~				~~7/16/86~~	
0033	05	FS2015	#4 FW NYLON		3.000	EA	4				7/16/86	
0034	05	FS3034	4-40 HEX NUT NYLON	BLK	1.000	EA	4				7/16/86	

MODEL NO. 7600A

AL 087268
[ASSY. No.]

CHANGE RECORD SHEET

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
7-15-8			COMPUTER RELEASE		
9-18-8	A	7483	Chg Items 8 & 12 Del Item 15		
1-28-8	A1	7627	Chg Items 6 & 7		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 087268 CROSS REF ITEM DESCRIPTION ASSY.BRIDGE COMPLETION ENGR DRAW DEP BATCH QTY 1 EFFEC 8/07/89 ITEM TYPE I UNIT MEAS EA LOW LEVEL 03 PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST UP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
	06	236533	HEADER 36 PIN .1 CTR	SAM TSW-136-09-G-S	.333	EA	4					
0000	04	087188	ARTWORK.P.C. BOARD	DEP	.000	EA	3				12/14/87	
0000	04	087189	SCHEMATIC BRIDGE COMP	DEP	.000	EA	3				12/14/87	
0001	04	087187	P.C. BD. BRIDGE COMP 7600A	DEP	1.000	EA	4				12/14/87	
0002	05	232799	RESM* 37.4 K 1/10W 1% R7	RN55C3742F	1.000	EA	4				12/14/87	
0003	05	236513	RESW* 2.1 K 1/4W 1% IMP R8	M015	1.000	EA	4				12/14/87	
0004	05	236514	RESW 100 1/4W 1% IMP R22	M015	1.000	EA	4				12/14/87	
0005	05	236534	SPACER.NYL.047ID.156OD.25LGBIV	903-.250	13.000	EA	4				6/30/83	
0006	05	FS5025	JUMPER..1 IN 24 GA BUSS T-2.U1-8-2.V-8-2.7-5.1-3		5.000	EA	4					
0007	06	FS5021	JUMPER R10.R11	STK RD-1/4-Z	2.000	EA	4				11/29/88	
0008	05	236561	HEADER.11 PIN .1 CTR	SAM TSW-111-09-G-S	1.000	EA	0				8/12/88	
0009	05	236562	HEADER.14 PIN .1 CTR	SAM TSW-114-09-G-S	1.000	EA	2				6/24/83	
0010	05	236563	HEADER.17 PIN .1 CTR	SAM TSW-117-09-G-S	1.000	EA	2				6/24/83	
0011	05	236564	HEADER..3 PIN .1 CTR	SAM TSW-123-09-G-S	1.000	EA	2				6/24/83	
0012	05	236565	HEADER.30 PIN .1 CTR	SAM TSW-130-09-G-S	1.000	EA	2				8/12/86	
0013	05	233867	SWITCH.DIP 8 POS S1.S2.S3	EEC 2400086	3.000	EA	4				12/14/87	
0018	04	234386	RESP 1 1W 1% DAL R13	RS-1A	1.000	EA	4				12/14/87	

MODEL NO. 7600A

AL 087268-001
[ASSY. No.]

CHANGE RECORD SHEET

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
9-7-9			COMPUTER RELEASE		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM	CROSS REF ITEM	DESCRIPTION ASSY.BRDG COMP MAN T	DEP	BATCH QTY 1	ITEM TYPE J	LOW LEVEL 00
087268-001		ENGR DRAW		EFFEC 9/07/89	UNIT MEAS EA	PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0001	02	087268-003	ASSY.BRIDGE COMPLETION DEP MAKE INTO 087268-001. REPLACE R7 RES REMOVE R2. INSTALL JUMPER PER 087268		1.0000	EA	1				9/07/89	
0002	06	232840	RESMBLOG X 1/10W 1% R7	RN55C1003F	1.0000	EA	A				6/17/83	

MODEL NO. 7600A

AL 087268-002
[ASSY. No.]

CHANGE RECORD SHEET

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
9-7-9			COMPUTER RELEASE		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 087268-002 CROSS REF ITEM DESCRIPTION ASSY.BRDG COMP VOLTS INS DEP ENGR DRAW BATCH QTY 1 ITEM TYPE 0 LOW LEVEL 00 EFFEC 9/07/89 UNIT MEAS EA PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0001	02	087268-003	ASSY.BRIDGE COMPLETION DEP MAKE INTO 087268-002. REMOVE R8 RES.		1.000	EA	1				9/07/89	

MODEL NO. 7600A

AL 087268-003
[ASSY. No.]

CHANGE RECORD SHEET

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
9-7-9			COMPUTER RELEASE		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM C87268-003 | CROSS REF ITEM | DESCRIPTION ASSY.BRIDGE COMPLETION ENGR DRAW | DEP | BATCH QTY 1 EFFEC 9/07/89 | ITEM TYPE 1 UNIT MEAS EA | LOW LEVEL 02 PLANNER

ROM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
	06	236533	HEADER 36 PIN .1 CTR	SAM TSW-136-09-G-S	.333	EA	4					
0000	04	087188	ARTWORK.P.C. BOARD	DEP	.000	EA	3				12/14/87	
0000	04	087189	SCHEMATIC BRIDGE COMP	DEP	.000	EA	3				12/14/87	
0001	04	087187	P.C. BD. BRIDGE COMP 7600A	DEP	1.000	EA	4				12/14/87	
0002	05	232739	RESM* 37.4 K 1/10W 1% R7	RNS5C3742F	1.000	EA	4				12/14/87	
0003	05	236513	RESM* 2.1 K 1/4W 1% R8	IMP M015	1.000	EA	4				12/14/87	
0004	05	236514	RESM 100 1/4W 1% R22	IMP M015	1.000	EA	4				12/14/87	
0005	05	236534	SPACER.NYL.047ID.156OD.25LG6IV	903-.250	13.000	EA	4				6/30/83	
0006	05	FS5025	JUMPER..1 IN 24 GA BUSS T-1.U1-8-2.V-8-2.7-5.1-3		5.000	EA	4					
0007	06	FS5021	JUMPER R10.R11	STK RD-1/4-Z	2.000	EA	4				11/29/88	
0008	05	236561	HEADER.11 PIN .1 CTR	SAM TSW-111-09-G-S	1.000	EA	0				8/12/88	
0009	05	236562	HEADER.14 PIN .1 CTR	SAM TSW-114-09-G-S	1.000	EA	2				6/24/83	
0010	05	236563	HEADER.17 PIN .1 CTR	SAM TSW-117-09-G-S	1.000	EA	2				6/24/83	
0011	05	236564	HEADER.23 PIN .1 CTR	SAM TSW-123-09-G-S	1.000	EA	2				6/24/83	
0012	05	236565	HEADER.30 PIN .1 CTR	SAM TSW-130-09-G-S	1.000	EA	2				8/12/88	
0013	05	233867	SWITCH.DIP 8 POS S1.S2.S3	EEC 2400.80	3.000	EA	4				12/14/87	
0018	04	234386	RESP 1 1W 1% R13	DAL RS-1A	1.000	EA	4				12/14/87	

MODEL NO. 7600A

AL 86551
[ASSY. No.]

CHANGE RECORD SHEET

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
7-26-3			COMPUTER RELEASE		
2-24-4	A	6191	PART CHANGES		
2-24-4	B	6194	DUPLICATE STOCK NOS		
2-24-4	C	6234	CORRECT ERRORS		
2-24-4	D	6274	CHANGE ITEMS		
2-24-4	E	6295	CHANGE ITEMS		
2-24-4	F	6316	CHANGE ITEMS		
3-6-4	G	6350	CHANGE ITEM 23		
9-17-4	H	6568	DELETE ITEM 62		
6-19-5	J	6768	Cha Qty Item 62		
9-29-5	K	6858	Chg Qty Item 62		
2-17-6	L	6984	Cha Item 76		
10-3-6	M	7156	Chg Item 83		
3-19-7	N	7268	Cha Item 91 Add Item	93	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086551 CROSS REF ITEM DESCRIPTION ASSY,AUTO BAL,76004 ENGR DRAW DEP BATCH QTY 1 EFFEC 3/18/87 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 04 PLANNER

BOM ITEM	LL CO	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0000	05	086603	ARTWORK, P.C. BOARD	DEP	.000	EA	3				7/22/83	
0000	05	086622	SCHEMATIC	DEP	.000	EA	3				7/22/83	
0001	05	086504	PC BOARD AUTO BAL 76004	DEP	1.000	EA	4				6/16/83	
0002	05	231290	DIOD 400 V 1.5A CR1	GI W04M	1.000	EA	4				6/07/83	
0003	05	086524	P.C. BOARD SHIELD 76004	DEP	1.000	EA	3				8/05/83	
0004	05	236519	CAPC: .33 UF 50V 5% IMA C2	RA.A334J	1.000	EA	4				6/16/83	
0005	05	236530	CAPC: .68 UF 50V 5% IMA C3	RA.A684J	1.000	EA	4				6/16/83	
0007	05	232249	CAPV: .01 UF 100V10% CDC C5,C4	WMF1S1	2.000	EA	4				10/25/83	
0008	05	236523	CAPC: .01 UF 100V20% CTS C13,14	JC-103	2.000	EA	4				6/16/83	
0009	06	233043	CAPC: .1 UF 50V20% ERE C5,C6,C7,C8,C17,C18	RPE122Z5U104M	6.000	EA	4				10/25/83	
0010	05	236463	CAPC: 100 UF 63V 20% RUB C15,16	63TWM510M	2.000	EA	4				6/07/83	
0011	06	232115	CAPT: 4.7 UF 35V20% KOS C12	CTP-C-4.7/35	1.000	EA	4				6/16/83	
0012	06	233871	CAPT: 1 UF 25V10% KEM C10,11	T36PA105K035AS	2.000	EA	4				6/07/83	
0015	06	233331	DIOS 85 V 0035 CR1-CR8	1N4154	8.000	EA	4				6/16/83	
0016	05	231092	XSTRS NPN VCBO= 75 TO18 Q1,Q2	2N2222A	2.000	EA	4				8/05/83	
0019	05	230697	XSTRS ISLTR OPT XSTR U2,U4	MOT 4N27	2.000	EA	4				6/07/83	
0020	05	235531	ICC PCMTR/DIV 14STG-W/OSC U21	RCA CD4060BEX (GND)	1.000	EA	4				6/16/83	
0021	05	233479	ICC CTR/DIV 4STAGE-DIVX8 U19	RCA CD4022AEX (GND)	1.000	EA	4				6/07/83	
0022	05	233582	ICC DRGT 4XLINP U9	RCA CD4071BEX	1.000	EA	4				6/16/83	
0023	05	234932	ICC DRGT 2X4INP U20	RCA CD4072BEX	1.000	EA	4				6/16/83	
0024	05	236516	ICC SAR U18	MOT MC14559BCPS	1.000	EA	4				6/07/83	
0025	05	234515	ICC SAR EXP U7,8	MOT MC14539BCPDS	2.000	EA	4				6/07/83	
0026	05	231715	ICC ST HEX U5	NAT MM74C914N(A*)	1.000	EA	4				6/07/83	
0027	05	235539	ICL OPAMP PRCSN U1	HAR HA2-5135-5	1.000	EA	4				6/07/83	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM C86551 | CROSS REF ITEM | DESCRIPTION ASSY•AUTO PWL•760JA ENGR DRAW | DEP | BATCH QTY 1 EFFEC 3/16/87 | ITEM TYPE 1 UNIT MEAS EA | LOW LEVEL 04 PLANNER

COM ITEM	LL CO	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NBR	FIRST UP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0028	05	231675	ICL VR +15V 1.5A TO220NAT LM340T15 U13		1.000	EA	4				6/07/83	
0029	05	231791	ICL VR -15V -.5A TO220PCD UA79M15AUCQR U14		1.000	EA	4				6/07/83	
0030	05	236470	ICL OPAMP DUAL DIP8AT LF442CN U12•15•3•5		4.000	EA	4				6/07/83	
0031	05	231692	ICL ANOGT 4X2INP RCA CD4081BEX U10•U11		2.000	EA	4				6/16/83	
0032	05	236517	ICL DAC 12BIT MULT NAT DAC1020LCNA+ U17•16		2.000	EA	4				6/07/83	
0035	05	236567	PIN 2 POS 1.085 X .02 DIA SAM BMS-102-G-D P10		1.000	EA	2				6/23/83	
0037	05	236571	PIN 6 POS 1.085 X .02 DIA SAM BMS-106-G-D P17		2.000	EA	2				6/23/83	
0038	05	236591	HEADER•STRGHT 3 PIN .025 SQMET 1100-1-103-02 P2•P3		1.000	EA	4				6/29/83	
0040	03	236604	POTTO 3G K SPL 64X5C? R2•R3		2.000	EA	4				7/25/83	
0041	05	C86426-012	RESISTORS-MATCHED SET 20-10KDEP R26•R28 ARE 20K R29 IS 10K		1.000	ST	2				7/07/83	
0042	05	C86426-009	RESISTORS-MATCHED PR 10K DEP R7•R8 IS ONE PAIR R19•R20 IS ONE PAIR		2.000	PR	2				7/07/83	
0043	05	C86426-010	RESISTORS-MATCHED ST 10K DEP R9•R10•R11		1.000	ST	2				7/07/83	
0044	05	C86426-011	RESISTORS-MATCHED PR 100K DEP R23•R24		1.000	PR	2				7/07/83	
0045	05	232458	RESM 10.0 1/5W 1% R4	RN55C10R0F	1.000	EA	4				6/16/83	
0046	06	232777	RESM# 22.1 K 1/10W 1% R5	RN55C2212F	1.000	EA	4				6/16/83	
0047	05	232779	RESM# 23.2 K 1/10W 1% R6	RN55C2322F	1.000	EA	4				6/16/83	
0048	05	232864	RESM#11C K 1/10W 1% R30•R37	RN55C1103F	2.000	EA	4				7/25/83	
0050	05	232878	RESM#249 K 1/10W 1% R1•R32	RN55C2493F	2.000	EA	4				11/23/83	
0051	05	235537	RESM# 1 M 1/10W 1% R31•R33	RN55C1004F	2.000	EA	4				6/07/83	
0052	05	232502	RESM 30.1 1/10W 1% R34	RN55C30R1F	1.000	EA	4				7/25/83	
0053	05	232614	RESM# 49.9 K 1/10W 1% R35	RN55C4992F	1.000	EA	4				7/25/83	

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086551 CROSS REF ITEM DESCRIPTION ASSY-AUTO BAL-706-A ENGR DRAW DEP BATCH QTY 1 EFFEC 3/18/87 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 04 PLANNER

BOM ITEM	LL CO	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0059	05	232807	RESM= 45.3 K 1/10W 1% R39	RN55C4533F	1.000	EA	4				8/09/83	
0060	06	233140	RESC= 1.8 K 1/4W 5% P15	ALB RC07GF182J	1.000	EA	4				6/16/83	
0061	06	233145	RESC= 3 K 1/4W 5% R3	ALB RC07GF302J	1.000	EA	4				2/23/84	
0062	05	233146	RESC= 3.3 K 1/4W 5% P14,P18	ALB RC07GF332J	2.000	EA	4				6/07/83	
0063	07	233166	RESC= 22 K 1/4W 5% P25	ALB RC07GF223J	1.000	EA	4				6/16/83	
0064	08	233174	RESC= 47 K 1/4W 5% R21	ALB RC07GF473J	1.000	EA	4				6/16/83	
0065	08	233178	RESC= 68 K 1/4W 5% R22,12	ALB RC07GF683J	2.000	EA	4				6/16/83	
0066	05	233190	RESC= 82 K 1/4W 5% P13	ALB RC07GF823J	1.000	EA	4				6/16/83	
0067	08	233182	RESC=100 K 1/4W 5% R24,16	ALB RC07GF104J	2.000	EA	4				6/07/83	
0068	05	233221	RESC= 4.7 M 1/4W 5% R27	ALB RC07GF475J	1.000	EA	4				8/12/83	
0076	05	236558	SOCKET 5-PIN STRIP .1 CNTR J1-2	SAM SS-105-T-2	1.000	EA	2				2/17/86	
0077	05	234568	SOCKET 8 PIN FOR U2,U4	RBN ICN-263-S3G	2.000	EA	4				6/07/83	
0078	06	234569	SOCKET-8 PIN DIP FOR U3,5,12,13	RBN ICN-083-S3G	4.000	EA	4				6/07/83	
0079	05	230229	SOCKET-8 PIN-(TJ-5) FOR U1	BRS 831-55-22-094	1.000	EA	4				6/16/83	
0080	05	233394	SOCKET-14 PIN U8,9,10,11,20	RBN ICN-143-S3G	5.000	EA	4				6/07/83	
0081	05	230223	SOCKET-16 PIN FOR U6,7,16,17,18,19,21	RBN ICN-163-S3G	7.000	EA	4				6/16/83	
0083	05	237929	STANDOFF,1/4"RD X 1" PHEN	ATM 8161-PH-0440	2.000	EA	4				10/03/86	
0084	06	FS1039	4-40X0.250 MS PAN PH SS		2.000	EA	4				1/27/84	
0090	05	FS5016	LOCTITE CLEAR	LOC 420	.001	EA	4				7/05/83	
0091	05	FS1257	4-40X0.312 RD HD SLT NYLON		2.000	EA	4				11/13/86	
0092	05	FS2015	#4 FW NYLON		4.000	EA	4				11/13/86	
0093	05	FS3034	4-40 HEX NUT NYLON	ELK	2.000	EA	4				10/25/83	

MODEL NO. 7600A

AL 086551-001
[ASSY. No.]

CHANGE RECORD SHEET

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
10-5-3	C	—	COMPUTER RELEASE		
7-6-9	D		DEL. A/W & SCHEM. CHG I/T TO D		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM	CROSS REF ITEM	DESCRIPTION		BATCH QTY	ITEM TYPE	LOW LEVEL
086551-001		ASSY,AUTO VOLTAGE INS BAL		1	3	03
		ENGR DRAW		EFFEC 8/07/89	UNIT MEAS EA	PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0001	04	086551	ASSY,AUTO BAL.760UA DEP		1.000	EA	1				9/20/83	
0002	05	234750	BATTERY GE	0S250	1.000	EA	4				9/08/83	

CHANGE RECORD SHEET

[ASSY. No.]

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
9-8-3			COMPUTER RELEASE		
3-6-4	E	6295	CHANGE ITEMS		
10-8-6	F	7106	[redacted] Che Item 28		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 086551-002 CROSS REF ITEM DESCRIPTION ENGR DRAW VOLTAGE INSERTION BALANCE DEP BATCH QTY 1 EFFEC 12/11/86 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 03 PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0000	05	086603	ARTWORK. P.C. BOARD	DEP	.000	EA	3				9/02/83	
0000	04	086629	SCHEMATIC	DEP	.000	EA	3				9/02/83	
0001	05	086604	PC BOARD AUTO BAL 7600A	DEP	1.000	EA	4				9/02/83	
0002	05	086624	P.C. BOARD SHIELD 7600A	DEP	1.000	EA	2				9/02/83	
0004	05	231280	DIOB 400 V 1.5A	DI WO4M	1.000	EA	4				9/02/83	
0006	06	233871	CAPT: 1 UF 35V10% C10.11	KEM T368A105K035AS	2.000	EA	4				9/02/83	
0007	05	236460	CAPE: 100 UF 63V 20% C15.16	RUB 63TWMS100M	2.000	EA	4				9/02/83	
0008	05	236528	CAPC: .01 UF 100V20% C13.14	CTB DC-103	2.000	EA	4				9/02/83	
0011	05	236470	ICL OPAMP DUAL U3.5	DIPNAT LF442CN	2.000	EA	4				9/02/83	
0012	05	231675	ICL VR +15V 1.5A U13	TO220NAT LM340T15	1.000	EA	4				9/02/83	
0013	05	231781	ICL VR -15V -.5A U14	TO220FCD UA79M15AUCQR	1.000	EA	4				9/02/83	
0016	08	233174	RESC* 47 K 1/4W 5% R21	ALB RC07GF473J	1.000	EA	4				9/02/83	
0017	08	233178	RESC* 68 K 1/4W 5% R22.12	ALB RC07GF683J	2.000	EA	4				9/02/83	
0018	05	086426-009	RESISTORS-MATCHED PR 100K R7&R8 ONE PR. - R19.R20 ONE PR.	DEP	2.000	PR	2				9/02/83	
0019	05	086426-010	RESISTORS-MATCHED ST 100K R9.10.11	DEP	1.000	ST	2				9/02/83	
0020	05	086426-011	RESISTORS-MATCHED PR 100K R23.24	DEP	1.000	PR	2				9/02/83	
0023	06	234569	SOCKET-8 PIN DIP	RBN 1CN-083-S3G	2.000	EA	4				9/02/83	
0024	05	236571	PIN 6 POS 1.085 X .02 DIA P101	SAM BBS-106-G-D	2.000	EA	2				9/02/83	
0025	05	236581	HEADER STRGHT 3 PIN .025 SQ	MET 1100-1-103-02	1.000	EA	4				9/02/83	
0028	05	237929	STANDOFF.1/4"RD X 1" PHEN	ATM 8161-PH-0440	2.000	EA	4				10/03/86	
0030	04	FS1231	6-32X0.375 MS PA SLT NYLON		2.000	EA	4				9/02/83	
0031	04	FS3017	6-32 HEX NUT.NYLON		2.000	EA	4				9/02/83	
0032	05	FS5016	LOCTITE CLEAR	LOC 420	.001	EA	4				9/02/83	
0084	06	FS1039	4-40XG.250 MS PAN PH SS		2.000	EA	4				3/05/84	
0091	05	236576	PLUG PLASTIC .125 HOLE	FTX 207-080501-00	2.000	EA	4				3/05/84	
0092	05	FS2015	#4 FW NYLON		1.000	EA	4				3/05/84	

CHANGE RECORD SHEET

[ASSY. No.]

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
3-9-4	—	——	COMPUTER RELEASE		
7-21-5	A	6857	Add Washers		
6-9-7	B	7299	Add Item 1		

JAYBEE OFFSET PRTG — 380-4700

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 400172 CROSS REF ITEM ENGR DRAW DESCRIPTION 7914AR/VX-2 CABINET DEP BATCH QTY 1 EFFEC 6/09/87 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 00 PLANNER

BOM ITEM	LL CO	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0000	01	086662	WIRE LIST	DEP	.000	EA	3				3/07/84	
0000	01	086668	SCHEMATIC, CABINET	DEP	.000	EA	3				3/07/84	
0000	01	086669	SYSTEM WIRING, CABINET	DEP	.000	EA	4				3/07/84	
0001	01	087069	FLEX CIRCUIT		1.000	EA	4				6/09/87	
0004	01	086645	PANEL-REAR-SS (086644)	DEP 7914AR/VX	1.000	EA	9				11/30/83	
0006	01	082659	PLATE-CONN MTG	DEP	1.000	EA	4				11/30/83	
0007	01	033626	BRACKET 7914R PLATE	DEP	4.000	EA	2				11/30/83	
0008	01	082790-3	CABINET-WRAP AROUND & BASE	DEP	1.000	EA	4				11/30/83	
0009	02	083084-3	TRIM STRIP 7914	DEP	2.000	EA	2				11/30/83	
0011	04	230641	GUARD,FINGER	RTN 47604-2	1.000	EA	4				11/30/83	
0012	04	230534	FAN,MARK 4	RTN MU2A1	1.000	EA	4				11/30/83	
0013	03	231448	CORD,LINE	BEL 17250	1.000	EA	4				11/30/83	
0014	01	230716	FILTER,RFI	CRM 6EFI	1.000	EA	4				11/30/83	
0016	01	230505	FUSE,HOLDER	LTF 342012A	1.000	EA	4				11/30/83	
0017	04	231489	FUSE,5 AMP (SLO-BLO)	LTF 313005	1.000	EA	4				11/30/83	
0018	01	230765	POST-BINDING-METAL	GER 938-P	1.000	ST	4				11/30/83	
0022	04	233759	GROMMET	HHS 91114	10.000	EA	4				11/30/83	
0023	01	230673	BUMPERS	RCT 3155	2.000	EA	4				11/30/83	
0025	01	231232	CONN J1-J10	AMP 26-190-32	10.000	EA	4				11/30/83	
0028	01	230066	CONN J21-J30	CON MS3102A-20-27S	10.000	EA	4				11/30/83	
0033	05	231234	CONN J31-J50	AMP 31-10	20.000	EA	4				11/30/83	
0039	01	233919	CONN J51	CON MS3102A-22-14P	1.000	EA	4				11/30/83	
0045	04	230062	CONN J52,J53	CON MS3102A-10SL-3P	2.000	EA	4				11/30/83	
0046	02	233612	WASHER-NYLON SHOULDER	SSM 5607-10	20.000	EA	4				9/27/85	
0047	05	FS2015	#4 FW NYLON		2.000	EA	4				9/27/85	

CHANGE RECORD SHEET

[ASSY. No.]

DATE	REV. LEVEL	ECO OR ECR #	DESCRIPTION OF CHANGE	REASON FOR CHANGE	APPROVAL
3-9-4	—	——	COMPUTER RELEASE		
9-17-4	A	6567	CHG ITEM 4		

PRINT PHANTOM ITEMS
PRINT COMPONENTS
PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM	CROSS REF ITEM	DESCRIPTION CONN. MATING	DEP	BATCH QTY 1	ITEM TYPE 2	LOW LEVEL 00
086660		ENGR DRAW 7914AR/VX-Z		EFFEC 9/17/84	UNIT MEAS EA	PLANNER

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	UM	ITEM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
0001	01	230071	CONN P21-P30	CON MS3106A-20-27P	10.000	EA	4				3/09/84	
0002	01	230470	CLAMP CABLE FOR P21-P30,P51	CON AN3057-12	11.000	EA	4				11/30/83	
0003	01	230069	CONN P52,P53	CON MS3106A-10SL-3S	2.000	EA	4				11/30/83	
0004	01	230472	CLAMP CABLE 7914R/VR FOR P52,P53	CON AN3057-4	2.000	EA	4				9/17/84	
0005	01	233912	CONN P51	CON MS3106A-22-14S	1.000	EA	4				11/30/83	
0006	03	231203	CONN P31-P50	AMP UG88/U	20.000	EA	4				11/30/83	

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